2023-2024 CATALOG

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About WPI

WPI Mission and Values

WPI's Mission

WPI transforms lives, turns knowledge into action to confront global challenges, and revolutionizes STEM through distinctive and inclusive education, projects, and research.

Our Values

Respect: We treat others with dignity at all times. We embrace expertise, including that earned through both education and lived experience. As global citizens, we respect our natural environment and acknowledge the responsibility we all have to develop and disseminate sustainable stewardship practices for our planet. We are committed to building a workplace and a campus where all can contribute, where all voices are valued, and where we engage and communicate with care and professionalism.

Community: We work from a collective vision and purpose to break down barriers to advancing our mission. We embrace opportunities to work collaboratively across disciplines, backgrounds, and organizations to craft better solutions to global and local challenges. We engage diverse perspectives to advance the university to greater heights. We embrace a true spirit of partnership to advance our shared mission, actively seeking partners across our campus and beyond as we commit to elevate our impact.

Inclusion: We seek a campus where everyone feels a sense of belonging and all can thrive. We respect differences and the complex identities of each member of our community. We are courageous in our efforts to reduce systemic barriers to success for minoritized groups. We promote and support diversity while actively working to advance equity on our campus and beyond.

Innovation: We commit to creating value in all that we do. We approach challenges with the creativity and resilience to make change where it is needed. We act as catalysts to make the world better. We embrace and celebrate learning for all. We act ethically, recognizing how innovation affects different populations by creating learning environments that reflect a broad diversity of experience, perspective, and identities.

Achievement: We are intentional in creating great experiences and results for all students, while embracing the importance of balance and well-being. We are outcomes-focused and are committed to creating positive societal change through our work. We tackle the world's great problems with innovative solutions born of diverse perspectives. We recognize and celebrate successes and proudly learn from failures.

(Adopted by the Board of Trustees, October 29, 2021)

The Two Towers Tradition: The Second Century

WPI, the nation's third oldest private technological university, was established in 1865 by the New England industrialists John Boynton, Ichabod Washburn, and their associates. Boynton and Washburn endowed the first two buildings on campus, as academic classrooms and practical shops. Boynton Hall and the Washburn Shops — renovated today into state-of-the-art facilities — still preserve their distinctive original towers. These "Two Towers" represent WPI's continued commitment to academic excellence through real-life project experience that synthesizes classroom learning.

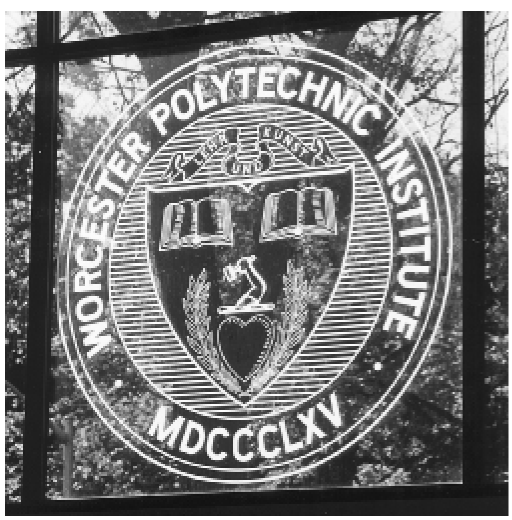
The "Two Towers" tradition of academic achievement and practical application is reflected in WPI's motto, "Lehr und Kunst" or "Theory and Practice."

WPI has awarded graduate degrees since 1898, adding new programs regularly in response to the developing needs of the professional world. WPI is among the top 50 science colleges in the nation in terms of the percentage of undergraduates who receive doctorates. Presently, WPI offers the master's degree in 31 disciplines and the doctorate in 15.

The current student body of over 4,000 men and women includes about 1,100 full- and part-time graduate students. Currently, students attend WPI from almost every state and over 70 foreign nations.

WPI’s Commitment to Pluralism

Pluralism, as a social condition, means that several distinct ethnic, religious, and racial communities live side by side, have equitable access to resources, are willing to affirm each other’s dignity, are ready to benefit from each other’s experiences, and are quick to acknowledge each other’s contributions to the common welfare. Recognizing the importance of pluralism to creativity, innovation, and excellence, WPI is dedicated to creating an atmosphere that encourages diversity in all aspects of campus life–from academics, to residence hall living, to social interactions among students, faculty, and staff. The Institute recognizes the special obligation of promoting a multicultural community based on mutual respect and tolerance. This commitment is part of WPI’s institutional plan for encouraging pluralism and increasing diversity, a plan that proclaims the importance of having students understand and appreciate other cultures, and prepares them fully to pursue rewarding careers in an increasingly global economy. *(Concepts endorsed by the WPI Faculty on April 21, 1994)*



Undergraduate Education

A Statement of Values for Undergraduate Education at WPI

1. WPI's programs shall emphasize fundamental concepts, knowledge, and skill, and ensure that students are able to apply them within the context of their major disciplines.
2. WPI's programs shall emphasize the development of students as effective thinkers and communicators, able to use evidence to present their ideas with logic, clarity, and persuasion.
3. Programmatic breadth in general, and balance between technical and humanistic components in particular, are the hallmarks of a WPI undergraduate education. In addition to educating students in their major discipline, WPI's programs shall provide students with a broad preparation for fulfilling lives as responsible professionals and informed citizens.
4. Grounded in project and course experiences, a WPI education shall provide a firm foundation for life-long learning in a variety of fields. WPI programs shall emphasize inquiry-based learning and open-ended problem solving. Students shall bear a considerable responsibility for learning outside of the classroom.
5. WPI's programs shall be sufficiently flexible so as to allow students significant choice in and responsibility for planning their courses of study. Faculty, via the central teaching tasks of project and academic advising, shall ensure that student learning experiences encourage critical reflection, decision making, and personal growth.
6. WPI's programs shall emphasize the scientific, technical, societal, and humanistic contexts in which knowledge is applied and constructed. Education activities shall challenge students to make connections between disciplines, to consider multiple viewpoints, and to appreciate the consequences of their actions. The curriculum shall prominently feature integrative and interdisciplinary activities.
7. WPI's learning environment and educational activities shall balance personal responsibility and individual accountability with cooperation, collaboration and mutual respect. Members of the community shall be encouraged to value academic integrity, and to become conscious of the value that such integrity confers to themselves and to the community.
8. WPI shall be committed to assessment and improvement of student learning.

WPI Undergraduate Learning Outcomes

Graduates of WPI will:

1. have a base of knowledge in mathematics, science, and humanistic studies.
2. have mastered fundamental concepts and methods in their principal areas of study.
3. understand and employ current technological tools.
4. be effective in oral, written and visual communication.
5. function effectively both individually and on teams.
6. be able to identify, analyze, and solve problems creatively through sustained critical investigation.
7. be able to make connections between disciplines and to integrate information from multiple sources.
8. demonstrate global and intercultural competency by developing the capacity to identify, explain, and critically analyze the forces (such as cultural, historical, political, economic) that shape the self and others as they engage with local and global communities.
9. be aware of personal, societal, and professional ethical standards.
10. have the skills, diligence, and commitment to excellence needed to engage in lifelong learning.

The WPI Plan

In 1970 WPI adopted a revolutionary new undergraduate program known as the WPI Plan. The Plan replaced the traditional rigidly-prescribed curriculum — typical of conventional engineering and science education — with a flexible, exciting, and academically challenging program aimed at helping students to learn how to learn. The Plan continues the "Two Tower" tradition by synthesizing classroom experience in projects that solve realworld problems. The WPI project program prepares graduates for their future professional lives by helping them learn how to identify, investigate and report on open-ended problems. Alumni indicate that project experiences also prepare them uniquely well for managing team efforts, and for communicating both in oral and written forms according to professional standards.

All WPI students complete two major projects in addition to requirements in general education and in their major fields. The Major Qualifying Project (or MQP) challenges students to solve research and design problems typical of those encountered in their professional discipline. The Interactive Qualifying Project (or IQP) presents an issue at the intersection of science, technology, and culture, and emphasizes the need to learn about how technology affects societal values and structures. Students also achieve intellectual breadth through degree requirements in the social sciences and humanities and arts. In addition, students achieve some depth within the Humanities and Arts by completing an Inquiry Seminar or Practicum on a theme emerging from a self-selected series of courses. Taken together, these activities emphasize that professionals must learn not only to create technology, but also to assess and manage the social and human consequences of that technology.

About the Catalog

Currency of Information

The information contained in this Undergraduate Catalog is not a complete statement of all the policies, practices, rules and regulations of Worcester Polytechnic Institute. Any statement made in this publication is for current informational purposes only and is subject to change by the governing body of WPI or its duly authorized representatives. Certain policies, rules and regulations are not published in this publication but are promulgated directly by the appropriate department. Members of the WPI community are expected to abide by the current policies, practices, rules and regulations of the college, even though they may not be contained in this publication or may not be consistent with the information contained in this publication, whether due to a properly authorized change or to a printing error.

Changes, deletions, and additions authorized by the governing body of WPI, after the printing of this catalog, are posted on WPI's web page at www.wpi.edu/ as a supplement to the undergraduate catalog, and includes the effective date of the action.

About Course Descriptions

Course Categories

For purposes of planning programs of study, courses at WPI are divided into three categories

Category I (Cat. I)

These courses cover core material of interest to large numbers of students. Category I courses are offered at least once a year.

Category II (Cat. II)

Category II courses are offered at least every other year

Category III (Cat. III)

Category III courses are offered at the discretion of the department/program.

Background

Recommended

The course will build on material in the recommended course. Instructors can assume that the student is knowledgeable of the material from the recommended course or from other experiences.

Suggested
The material from this course would be helpful to the student, but it is not assumed background.

WRITING-INTENSIVE (WI) COURSE SECTIONS
Some sections of WPI courses may be labeled as "WI" in the course schedules. These sections will:

- Assign writing to teach course content and disciplinary forms of communication and reasoning;
- Provide explicit instruction in and feedback on students' written work; and
- Specify and require standards for ethical writing practices.

Catalog and Schedule
The catalog and course schedule can be found online at https://www.wpi.edu/academics/calendar-catalogs and https://courselistings.wpi.edu.

Course Numbering
Each course at WPI is designated by a prefix identifying the subject area followed by a four digit number. The first digit is coded as follows:

1 — Courses for which first-year students will receive priority in registration. Upper class students may register on a space-available basis.

2 — Basic level courses.

3 — Advanced level undergraduate courses for which no graduate credit is given. (This restriction may be waived at the discretion of the degree department.)

4 — Advanced level undergraduate courses for which graduate credit may also be given.

5 — Graduate courses.

The last three digits may be used by the departments to indicate subject areas. Many graduate courses are also available to undergraduates.

Course Credit
Unless otherwise indicated, WPI courses usually carry credit of 1/3 unit. This level of activity suggests at least 15-17 hours of work per week, including work outside the classroom, as well as scheduled class and laboratory time. The usual workload per term is 1 unit.

Accreditation

Accreditation
Worcester Polytechnic Institute is accredited by the New England Commission of Higher Education (formerly the Commission on Institutions of Higher Education of the New England Association of Schools and Colleges, Inc.).

Accreditation of an institution of higher education by the Commission indicates that it meets or exceeds criteria for the assessment of institutional quality periodically applied though a peer review process. An accredited college or university is one which has available the necessary resources to achieve its stated purposes through appropriate educational programs, is substantially doing so, and gives reasonable evidence that it will continue to do so in the foreseeable future. Institutional integrity is also addressed through accreditation.

Accreditation by the Commission is not partial but applies to the institution as a whole. As such, it is not a guarantee of every course or program offered, or the competence of individual graduates. Rather, it provides reasonable assurance about the quality of opportunities available to students who attend the institution.

Inquiries regarding the accreditation status by the Commission should be directed to the administrative staff of the institution (gr-Accreditation@wpi.edu).

The aerospace engineering, architectural engineering, biomedical engineering, chemical engineering, civil engineering, electrical and computer engineering, environmental engineering, industrial engineering, and mechanical engineering programs are accredited by the Engineering Accreditation Commission of ABET, http://www.abet.org.

The Chemistry and Biochemistry Department and its program at WPI are approved by the American Chemical Society for a major in chemistry or biochemistry. Those chemistry majors who complete a program satisfying the guidelines established by the American Chemical Society are certified to that organization as having received an undergraduate professional education in chemistry or biochemistry.

The undergraduate and graduate business offerings in The Business School are accredited by AACSB International, the Association to Advance Collegiate Schools of Business. AACSB International is a not-for-profit organization consisting of more than 900 educational organizations and corporations. Its mission is excellence in management education in colleges and universities. Headquartered in Tampa, Florida, AACSB International is the premier accrediting agency and service organization for business schools.

Professionally Accredited Programs

WPI is accredited as an institution by the New England Commission of Higher Education. In addition, the aerospace engineering, architectural engineering, biomedical engineering, chemical engineering, civil engineering, electrical and computer engineering, environmental engineering, industrial engineering, mechanical engineering, and robotics engineering programs are accredited by the Engineering Accreditation Commission of ABET, http://www.abet.org. The Chemistry and Biochemistry Department and its program are approved by the American Chemical Society and the American Society for Biochemistry and Molecular Biology. The bachelor's and master's degree programs offered by The Business School are accredited by AACSB International — The Association to Advance Collegiate Schools of Business.

Policies & Practices

Notice of Nondiscriminatory Policy as to Students

It is the policy of Worcester Polytechnic Institute that each qualified individual, regardless of race, color, sex, religion, sexual orientation, national origin, age as defined by law, or handicap, shall have equal opportunity in education, employment or services of Worcester Polytechnic Institute. It is the policy of WPI to follow U.S. federal government eligibility guidelines in the administration of its institutional financial aid program.

Student Responsibilities for Ethical and Professional Conduct

WPI expects all its students to demonstrate the highest sense of honor in respecting academic and professional traditions such as acknowledging the borrowing or use of other people's ideas. Willful violations (like plagiarism) of such academic traditions or of legal restrictions (like those regarding copyright) will be considered violations of the "Campus Code" as described in the Student Planner.

WPI education is strongly committed to project-based learning, to providing students with access to state-of-the-art technology, and to working with professionals, on and off campus. Therefore, when students are exposed to proprietarial and/or confidential information, they must accept responsibilities appropriate to their preparation for life-long careers in which codes of ethics govern professional conduct.

Facilities such as the off-campus projects, employment sites, and on-campus laboratories permit students to gain experience with techniques at the forefront of industrial and research development. With this access comes the added responsibility of safeguarding students of any agreements they sign regarding conditions or restrictions for access to certain equipment or information will also be considered a violation of the "Student Code of Conduct".

Record of any penalties assigned by the WPI Campus Judicial System which result from violation of standards of ethical conduct will become a permanent part of that student's disciplinary record.

Student Absence Due to Religious Beliefs

Section 2B, Chapter 151C of the General Laws of the Commonwealth of Massachusetts: "Any student in an educational or vocational training institution, other than a religious or denominational educational or vocational training institution, who is unable, because of his/her religious beliefs, to attend classes or to participate in any examination, study, or work requirement on a particular day shall be excused from any such examination or study or work requirement, and shall be provided with an opportunity to make up such examination, study, or work requirement which he/she may have missed because of such absence on any particular day; provided, however, that such makeup examination or work shall not create an unreasonable burden upon such school. No fees or any kind shall be charged by the institution for making available to the said student such opportunity. No adverse or prejudicial effects shall result to any students because of his/her availing himself/herself of the provisions of this section."

Policy for Institutional Charges and Refunds for Students Called to Military Action

WPI recognizes the obligations of our students who are called to active duty by the U.S. Military. To support these students WPI has established this policy to facilitate their transition from, and back to active student status.

Such students shall receive 100% refund for the uncompleted term(s) of the semester at the date of the notice. If such student has a loan obligation to WPI they will be granted an in-school deferment status during the period of active duty service, not to exceed a total of three years.

To initiate the process to be classified "On leave for military service" the student must indicate, in writing, that he/she is requesting school deferment status while being called to active duty. A copy of the official call to active duty notice from the military must be included with this request and be submitted to the Registrar's Office.

WPI Directions

Driving to WPI

From the East:

Take Mass. Turnpike (I-90) to Exit 11A (I-495). Proceed north to I-290, then west into Worcester. Take Exit 18, turn right at end of ramp, then an immediate right before next traffic light. At next light, proceed straight through, bearing to the right on Salisbury St. At the WPI sign, turn left onto Boynton St., then right onto Institute Rd., then right onto West St. Visitor parking is on the left after footbridge.

From the North:

Take I-495 south to I-290. Follow directions as from east.

From the South and West:

Take Mass. Turnpike (I-90) to Exit 10 (Auburn). Proceed east on I-290 into Worcester. Take Exit 17, turn left at end of ramp, follow Rte. 9 west through Lincoln Sq., straight onto Highland St., then right at light onto West St. and through first intersection. Visitor parking is on the left after footbridge.

Admissions, Expenses, Financial Aid, and Housing

Admission to WPI

WPI recruits, selects, and enrolls first year and transfer students who are the best match for our dynamic and distinctive educational offerings. Our admissions professionals review all students holistically taking into account each student's qualitative and quantitative materials within their specific context.

Selection for admission to WPI is based upon many factors including, but not limited to, academic preparation, grades, trends in academic performance, the personal essay, recommendations, co-curricular and extracurricular activities. Candidates are allowed to submit supplemental material that they believe is relevant to the admissions committee's evaluation of their application.

Visiting

WPI offers in-person and virtual opportunities for students to explore campus, and engage with students and faculty including:

Daily information sessions & tours (weekdays & select Saturdays)
Virtual online campus tour
Fall Open Houses (for prospective & applying students)
Accepted Student Days (for accepted students)

Visit www.wpi.edu/+visit for more information or to register for visit or event.

Admissions Office Hours

The admissions office is open Monday – Friday 8:30am–5:00pm throughout the academic year. Summer hours (mid-May through the end of August) are 8:00am–4:00pm.

Contact Information

Phone: (508) 831-5286
Email: admissions@wpi.edu

Admissions Requirements

The basic academic requirements for first-time first-year applicants include:

- Four years of English
- Four years of math (including pre-calculus)
- Two years of lab science
- Other application requirements for the evaluation process include:
  - Official high school transcript
  - Recommendations from a teacher and a School or College counselor
  - A personal essay
  - Early Decision Agreement (for candidates who select the Early Decision application plan)

WPI is a test blind university. SAT and ACT scores will not be considered in the admission process.

International students whose first language is not English are required to submit TOEFL, IELTS or Duolingo scores.

Applying to WPI

WPI is a member of the Common Application, and the Common Application is the exclusive method by which first year candidates apply to WPI. All first year candidates must complete their application no later than February 1 for consideration.

Application deadlines*:

Early Action: November 1
Early Decision I: November 1
Early Action Round II: January 5
Early Decision II: January 5
Regular Decision: February 1

Notification deadlines*:

Early Action: late January
Early Decision I: mid December
Early Decision II: mid February
Early Action Round II: late February
Regular Decision: late March

*Dates are subject to change. Visit www.wpi.edu/admissions/undergraduate for the most up-to-date information regarding deadline and notification dates.

Financial Aid

Students applying for financial aid must check the appropriate box on the application for admission to be considered for financial aid. Financial aid candidates should submit the College Scholarship Service (CSS) Profile Application and the Free Application for Federal Student Aid (FAFSA), which are available online at www.cssprofile.org and www.studentaid.gov. For all admission applicants, these forms should reach the WPI Office of Student Aid & Financial Literacy by the same deadline dates listed above for Admission applications. Financial Aid is available for U.S. citizens and/or permanent residents of the U.S. A limited amount of need-based financial aid is available for International Students. In order to apply for need-based assistance, international students must complete the international CSS Profile online at www.cssprofile.org.

Notification

All candidates for admission will receive an online acknowledgment of the receipt of their application. Admissions decisions are available exclusively through WPI's online portal and are not mailed to applicants. Decisions will be available to all applicants no later than April 1.

Decision to Matriculate

Accepted first year candidates must inform the college by 11:59 PM on May 1 of their decision to matriculate and submitting a $500 non-refundable tuition deposit. Students admitted under an Early Decision plan will have 30 days to submit their $500 non-refundable enrollment tuition deposit. Any deposits mailed in must be post-marked on or before May 1. WPI reserves the right to return deposits received after this date.

Admissions Terms and Conditions

Please note that WPI's offer of admission and your subsequent matriculation at WPI is contingent upon the following terms and conditions.

Matriculation for the purposes of these terms and conditions is defined as the earlier of a student's arrival on campus or WPI's first day of classes for the term/semester.

WPI reserves the right to revoke your offer of admission any time prior to your matriculation at WPI if:

- You do not graduate or do not receive a diploma at the end of the academic year.
- You have misrepresented any part of your admissions application, including but not limited to any behavioral or disciplinary issues and academic dishonesty.
- You experience a drop in grade performance during the remainder of the academic year.
- Information that comes to the attention of WPI that is deemed unacceptable by WPI.

Transfer Students

WPI welcomes applications from full- and part-time transfer students from accredited two- and four-year institutions. WPI looks for candidates with demonstrated strength in math, science, and computer or engineering coursework; transfer admission to WPI is highly competitive. WPI's minimum academic requirement for transfer admissions consideration is that candidates be enrolled in or recently completed precalculus and one college-level laboratory sciences at the time of submitting an application. However, please note it is the preference of the WPI admissions committee that the candidate complete calculus 1 and two college-level laboratory sciences at the time of submitting an application. While not required, successful transfer candidates have typically completed at least one full year of college (post high school graduation) by the time of intended enrollment, and have earned grades of Bs or better. Transfer candidates must be in good academic and disciplinary standing at all institutions in which they have been an enrolled student.

Applicants should be aware of the accelerated pace of WPI's academic calendar, which consists of four, seven-week terms instead of two semesters. A full-time course load is defined as three courses per term with classes meeting four or five days per week, while a part-time course load may not exceed three total courses per semester. A minimum of 8 units of work (or 72 credits) is the residency requirement for all students. Additionally, candidates should be aware that undergraduate classes are only offered during the day.

Transfer Admissions & Financial Aid

The WPI Transfer Application is available online at www.wpi.edu/+transfer. The fall entrance application deadline is May 15 with the review process typically beginning in late March each year. The spring entrance application deadline is November 15 with the review process beginning as soon as possible in October. Students are notified of an admissions decision on a rolling basis. Accepted transfer students for the spring semester will be required to enroll by December 15. Accepted transfer students for the fall semester will be required to enroll by June 30.

In addition to submitting the WPI Transfer Application, transfer applicants should provide their official college transcripts for each post-secondary institution attended, a final official high school transcript with proof of graduation, and one letter of recommendation. Students offered admission and enrolling should be aware that the WPI Conduct Record Release Form will be required prior to matriculation from any prior colleges/ universities attended. International transfer applicants must also submit English translations and course-by-course evaluations from a current NACES member for all non-US transcripts, proof of English Language Proficiency, and Proof of Financial Ability (if accepted to WPI) demonstrating funding for the total cost of education and living expenses (an I-20 will not be issued without this form).

Additional detailed information about the transfer application process as well as a link to the WPI Transfer Application can be found at www.wpi.edu/+transfer.

Transfer students may be eligible for need-based scholarship and loan funds from a variety of sources including WPI, the federal government, and some state government agencies. Need-based financial assistance is not available for part-time candidates or for international (non-U.S. citizen) transfer students. More information about the need-based aid process as well as transfer scholarship opportunities are available at www.wpi.edu/+finaid.

Transfer Agreements & Transfer Credit

WPI currently holds formal articulation agreements with specified programs of studies at Quinsigamond Community College (QCC) in Worcester, MA. However, WPI will grant appropriate transfer credit from any accredited two-year or four-year institution.

WPI will offer a transfer credit evaluation post admission to the university for transfer students, and after the May 1 enrollment deadline for incoming first year students (typically beginning in mid-May). Admitted transfer students and enrolled first year students should follow the WPI transfer credit guidelines, policy and procedure available at www.wpi.edu/+transfercredit. This site also includes a list of transfer equivalencies to date based on previously requested course reviews. The Transfer Admissions team coordinates the process with WPI faculty who evaluate the coursework to determine credit eligibility. Each academic department at WPI reviews courses under their program, and provides a decision to the Transfer Admissions team. Admissions communicates any credit review updates to the student, the WPI Registrar's Office and to WPI Academic Advising. In general, courses that are the academic equivalent of a WPI course with a grade of a C or better will be considered for transfer credit, with many academic departments requiring a B or better. College-level and lab-based chemistry and biology, calculus, calculus-based physics with lab, engineering science, and many social science and humanities and arts courses are typically considered eligible for transfer credit. For most coursework to be eligible for a transfer credit review, the coursework must be completed on a college campus taught by college instructors. Some online coursework may be eligible and is determined as part of the official course review process by evaluators. Early college, early entrance programs, or college coursework provided in partnership with a college or university but offered at the high school taught by high school teachers are not eligible for credit at WPI, with the exception of Project Lead The Way (PLTW). Online coursework is also typically not eligible, but is reviewed on a case-by-case basis. Additional courses that are not transferable include pre-calculus, non-calculus based physics or engineering science, and computer courses in BASIC.

Humanities & Arts Requirement for Transfer Students

As part of the WPI Plan, all WPI students must complete the Humanities and Arts Requirement. As such, all transfer students should review their humanities and arts coursework accepted for transfer credit at WPI and plan with the Humanities and Arts Department's coordinator for transfer students to determine next steps towards the completion of the HUA Requirement. All transfer students entering WPI with fewer than two units of humanities and arts credit must complete thematically related work in humanities and arts. This will include an inquiry seminar or practicum to the extent that the overall humanities and arts credit totals two units. The HUA Requirement is considered fulfilled for transfer students who have completed the equivalent of two units of humanities and arts work prior to their matriculation at WPI. A Completion of Degree Requirement form (or CDR) must be submitted once the HUA Requirement has been satisfied. This form can obtained through the WPI Registrar's Office, and will be completed by the Humanities and Arts Department coordinator for transfer students. For those transfer students who have satisfied the HUA Requirement based on work completed at their previous institution(s) and who submit the approved CDR form to the WPI Registrar's Office will have this information posted to their student account. This process normally takes place prior to or during the first term of full-time enrollment at WPI.

International Students

The presence of international students serves as a means of strengthening the knowledge and understanding of foreign countries and cultures and is highly encouraged and supported at WPI. Programs and support services for international students and exchange programs are given high priority. As an institution of higher learning, WPI is dedicated to international education.

International (non-immigrant) applicants must provide proof of English language proficiency. English language proficiency may be demonstrated by the official results of:

- TOEFL (Test of English as a Second Language)- recommended score of 90 with no sub-score below 20
- IELTS (International English Language Testing System) recommended score of 7.0 or higher with no band below 6.5
- Duolingo - recommended score of 125
- Pearson's Test of English - recommended score of 61

Financial Aid

WPI is committed to assisting students and their parents in finding ways to finance the cost of a WPI education through financial aid assistance and private financing options. Central to WPI's program is the concept of financial need. This concept is based on the assumption that parents and students together accept the responsibility for educational expenses to the extent they are able. Over 97% of full-time WPI undergraduates are receiving financial help from federal, state, and/or institutional resources (includes need and merit based aid). A combination of grants, loans and/or work study assistance from federal, state and WPI funding are allocated to students who demonstrate financial need. The proportion of grant, or "gift" assistance, versus loan and work, may be determined by the college on the following criteria: the magnitude of the financial need, the student's academic performance, and the availability of funds.

Application Procedures – Prospective Students

Students are required to file the Free Application for Federal Student Aid (FAFSA) and the CSS (College Scholarship Service) Profile Application. In the case of separation or divorce, the student's noncustodial parent must also complete a CSS Profile. Students list WPI's school code under the section on each form where it designates which schools are to receive the form. In addition, students whose financial aid applications are selected for verification* are required to submit additional documentation for themselves and their parents, if considered dependent. Generally, tax filers are required to either successfully utilize the IRS's Data Retrieval Tool on the FAFSA or submit a copy of their tax return transcript. Non tax filers are required to submit a copy of their W-2 statements as well as a non-filer statement from the IRS.

*Please visit www.wpi.edu/+faverification for more information on the verification process.

EARLY ACTION AND EARLY DECISION APPLICATION FOR FINANCIAL AID

Applicants must indicate on their admission application they are applying for financial aid. For those students applying for early action admission, the CSS Profile Application (and CSS Profile from Noncustodial parent, if applicable) can be submitted as early as October 1st, but no later than the posted Admission application deadlines. The FAFSA and the CSS Profile Application are available online at www.studentaid.gov and www.cssprofile.org.

Successful candidates for early action admission will be notified of financial aid eligibility on a rolling basis. Applicants will then have from the date of their aid eligibility letter until the candidates' common reply date, May 1st, to either accept or decline the aid offered.

To learn more about early decision, please visit this webpage.

The Early Decision I deadline is **November 1**, with a notification date of **December 15**.

The Early Decision II deadline is **January 15**, with a notification date of **February 15**.

Early Decision is ideal for students who know that WPI is their first choice, and, after careful research and consideration of all factors (residential, academic, social, and financial), are prepared to enroll at WPI if accepted.

REGULAR DECISION APPLICATION FOR FINANCIAL AID

Applicants must indicate on their admission application they are applying for financial aid. Successful candidates for admission will be notified of a financial aid decision in April if a complete financial aid application has been submitted. Applicants will then have from the date of the financial aid decision until the candidates' common reply date, May 1st, to either accept or decline the aid offered.

To ensure a complete review, the WPI Office of Student Aid & Financial Literacy must receive the FAFSA and the CSS Profile Application by February 15th. Applications completed after this date will be reviewed subject to available funding. The Office of Student Aid & Financial Literacy encourages students to complete the FAFSA and the CSS Profile Application (and CSS Profile from Noncustodial parent, if applicable), when the FAFSA and CSS Profile Application open October 1st to ensure that WPI's filing deadline of February 15th is met.

UPPERCLASS APPLICATION FOR FINANCIAL AID

Upperclass students who receive need based financial aid must reapply for financial aid every year by completing the FAFSA. In a few cases, some upperclass students will also be required to submit the CSS Profile Application in addition to these requirements. Typically, upperclass students who will need to complete the CSS Profile Application are those whose parents are recently separated or divorced, students who are re-admitted to WPI, students whose custodial and noncustodial parents have changed since the prior academic year, and students who did not apply for need based financial aid in the prior academic year. The WPI Office of Student Aid & Financial Literacy reserves the right to request that a CSS Profile Application be completed by any upperclass student applying for need based financial aid.

Filing information on the FAFSA (and CSS Profile Application, if necessary) is due by March 31st each year. In addition, students whose financial aid applications are selected for verification* are required to submit additional documentation for themselves and their parents, if considered dependent. Generally, tax filers are required to either successfully utilize the IRS's Data Retrieval Tool on the FAFSA or submit a copy of their tax return transcript. Non tax filers are required to submit a copy of their W-2 statements as well as a non-filer statement from the IRS. The complete application provides consideration for grants, scholarships, loans and federal on-campus employment for the following academic year. Students and their parent(s) are expected to obtain and submit all requested forms in a timely manner for each year of planned enrollment. If any of the required forms are submitted late, there will be a delay in the student receiving an aid offer and there may be a reduction in his/her grant or scholarship eligibility for the year in which he/she is applying for need based financial assistance. The amount of financial aid upperclass students receive will depend on their academic performance from the prior academic year, their family's demonstrated financial need which is determined from the FAFSA, and the CSS Profile Application, if required.

*Please visit www.wpi.edu/+faverification for more information on the verification process.

TRANSFER STUDENTS

Transfer students may apply for financial aid eligibility beginning with their first term of matriculation and must indicate interest in financial aid on the admission application. Please note that financial aid is not available for part-time or international (non-U.S. citizen) transfer students. Transfer aid applications will be reviewed based on the same documentation required for first year applicants and are packaged on a funds available basis. The FAFSA and CSS Profile (and CSS Profile from Noncustodial parent, if applicable) are due by May 15. In addition, students whose financial aid applications are selected for verification* are required to submit additional documentation for themselves and their parents, if considered dependent. Generally, tax filers are required to either successfully utilize the IRS's Data Retrieval Tool on the FAFSA or submit a copy of their tax return transcript. Non tax filers are required to submit a copy of their W-2 statements as well as a non-filer statement from the IRS.

*Please visit www.wpi.edu/+faverification for more information on the verification process.

Forms of Aid

FEDERAL PELL GRANTS

Federal Pell Grants are awarded to high-need students from low, and lower, middle-income families. For the 2022-2023 academic year (July 1, 2022, through June 30, 2023) the maximum Federal Pell Grant will be $6,895. The amount an individual student may receive depends on a number of factors (including the Expected Family Contribution, cost of attendance and enrollment status).

FEDERAL SUPPLEMENTAL EDUCATIONAL OPPORTUNITY GRANTS (FSEOG)

The Federal Supplemental Educational Opportunity Grant is a Federal grant awarded to low income, undergraduate degree-seeking students who are also Federal Pell Grant recipients. Award amounts range per academic year and will not exceed $4,000 per year. Awards are based on the availability of funds. The funding is provided to WPI from the federal government. This grant is for one year only and is not guaranteed in subsequent years. Funding is limited.

FEDERAL DIRECT STUDENT LOAN

For information on loans, including the Federal Direct Loan programs, WPI institutional loans, and private education loans available to families please visit our website (https://www.wpi.edu/admissions/tuition-aid/types-of-aid/loans-financing).

FEDERAL WORK STUDY PROGRAM

For more information on Federal Work Study (FWS), please visit this website (https://www.wpi.edu/admissions/tuition-aid/types-of-aid/federal-work-study-program). Awarded students will be sent additional information by the Office of Student Aid & Financial Literacy to their WPI email address about working on campus shortly before each academic year begins. Federal Work Study is not available in the summer terms. Obtaining a

FWS position (and completing the required community service earnings), either on-or off-campus, is the responsibility of the student. There is a minimum requirement of earnings that must be achieved each academic year - which is one of the requirements for retaining funding in the subsequent academic year.

STATE SCHOLARSHIP PROGRAMS

The MASSGrant is awarded to Massachusetts residents whose combined family contribution falls within state-determined parameters. Students must file the FAFSA by the state-designated deadline and follow all state program procedures to apply.

Massachusetts has reciprocity agreements with Pennsylvania and Vermont. These states allow their residents attending institutions in Massachusetts to "carry" need-based state grants into Massachusetts. Awarding from other state scholarship programs depends on annual state funding levels.

The Massachusetts Gilbert Matching Grants Program is allocated annually to WPI. These funds are awarded to Massachusetts residents who fall within a certain financial need.

Learn more here: https://www.wpi.edu/admissions/tuition-aid/types-of-aid/scholarships-grants.

STATE FUNDED STUDENT LOAN PROGRAMS

The Commonwealth of Massachusetts provides the Massachusetts No Interest Loan (MA NIL) Program through annual allocations to participating colleges and universities. Students who file the FAFSA and meet state eligibility criteria are eligible for the Massachusetts No Interest Loan on a funds available basis.

WPI COLLEGE SCHOLARSHIP

WPI awards College Scholarships and other restricted or endowed "gift" assistance, to students who have a demonstrated financial need based on review of the completed financial aid application, including the FAFSA, the CSS Profile Application (if first year applicant), IRS Data Retrieval Tool, and W-2 forms (if selected for verification). WPI gift aid may be combined with federal and state grants to make up a student's total portion of "gift" assistance, before loans and work are packaged.

WPI INSTITUTE STUDENT LOAN PROGRAM

The WPI Institute Loan is an institutional need-based loan awarded to students. Repayment of the principal and interest begins 9 months after the last day of enrollment or withdrawal from college. Learn more here.

FEDERAL DIRECT PLUS LOANS

Federal Direct PLUS Loans are available annually to parents of dependent undergraduate students. Repayment begins when the funds are advanced to the school with the option to defer repayment until after the student graduates or falls below half-time enrollment status. Parents have 10 years to repay the Federal Direct PLUS Loan. Learn more here.

WPI DEPARTMENT-FUNDED WORK PROGRAM

Students who are not eligible for Federal Work Study funds may seek employment opportunities through departments or offices on campus that set aside funds for hiring undergraduate employees. These employment funds vary from year to year in terms of monies available or the number of students allowed per department/office. Students may also inquire about department-funded summer positions on campus.

Financial Aid Policies

Financial aid is awarded one year at a time. Aid applicants are required to reapply annually by the end of the academic year for the next academic year. A student's financial need is reviewed annually through the FAFSA to ensure that aid is renewed equitably, as different circumstances may cause needs to change. The WPI Office of Student Aid & Financial Literacy determines a student's financial need through a review of the completed financial aid application.

Financial aid offers are made available in the student's portal (www.wpi.edu/+fastatus) in July for the following academic year. If an aid offer is not available when a student anticipates receiving one, contact the office to determine why - finaid@wpi.edu or 508-831-5469.

Students should monitor their WPI email and check their portal for missing documents or requirements throughout the summer. If a student is selected for verification, the Office of Student Aid & Financial Literacy will not review the student for awarding until they submit all verification documents and are verified. Please visit www.wpi.edu/+faverification for more information on the verification process.

STUDENT CONTRIBUTION

It is expected that the student's family will contribute its maximum financial effort and that the student will also make a maximum effort through savings from annual earnings, and by accepting a proportion of financial aid in the form of loans and/or in-school employment, if eligible. Students at WPI are expected to contribute a minimum $2,750 each academic year from summer or other annual earnings. While this minimum student contribution is used, the WPI Office of Student Aid & Financial Literacy must review previous calendar year student earnings and student savings/assets as the basis for determining the annual student contribution.

INDEPENDENT/DEPENDENT STUDENT STATUS

WPI believes that the primary responsibility for an undergraduate education lies with the student and parent(s), to whatever extent possible. Therefore, all undergraduates applying for WPI institutional funds are required to provide parental information regardless of federal dependency status.

Although a student may meet federal guidelines to be considered an independent student, and therefore receive federal funds as an independent student, the ability of parents to assist their children, regardless of age and dependency status, is a factor WPI considers in determining eligibility for institutional need-based grants. Because of this, the WPI Office of Student Aid & Financial Literacy will require parental information from all students applying for need based institutional aid.

AID RETENTION/PROGRESS TOWARD A DEGREE

The Institutional (WPI) financial aid retention policy is found here.

All full time students are expected to register and enroll in the equivalent of 36 credits (12 classes) each academic year*.

A student must pass a minimum of 24 academic credits each academic year (A through D term) to keep the same level of WPI institutional funding for the following academic year.

AP courses, transfer credit, incomplete grades or extensions are not counted in the number of credits passed. The student is responsible for resolving any incomplete grades with the faculty member assigning the grade.

If a student does not meet the minimum number of academic credits required in an academic year (A-D term), their WPI merit based scholarships will be reviewed and a percentage of their merit scholarship may be reduced based on the number of courses they did not pass.

Reductions to WPI merit-based scholarships begin at having passed only 21 credits, which results in a 5% decrease in funding. WPI merit-based scholarships will continue to be reduced by 5% for every 3 credits not passed.*

Students are able to submit an appeal due to a loss of funding related to their academics. Please reach out to finaid@wpi.edu to obtain the appeal form.

**There are exceptions for students on an approved reduced course load, participating in a Co-Op experience, or returning from a Leave of Absence, for example.*

Federal and/or State Financial Aid

For retention of federal and/or state financial aid funding. Please refer to these aid policies here.

WPI Need Based Scholarships

WPI need based scholarships awarded to students will not increase in future academic years regardless of changes in a student's financial need. However, student's WPI need based scholarships may decrease based on a lower financial need and/or poor academic performance (from the prior academic year).

WPI Merit Scholarships

WPI merit scholarships will not increase or decrease based on changes to a student's financial need. However, a student's merit scholarship will decrease or be eliminated if a student does not pass a minimum of 24 academic credits per year.

Eligibility for consideration for all types of financial aid for the following academic year is lost if a student is placed on Academic Probation (D term). If a student is placed on Academic Probation, they may submit an appeal form. Please email finaid@wpi.edu to learn more and obtain this form.

Financial Aid Appeals

Students placed on Academic Probation, have lost a portion of or all of their merit scholarship and/or are placed on federal financial aid suspension, may in some cases which involve unusual and extenuating circumstances such as documented medical problems, file a financial aid petition with the WPI Office of Student Aid & Financial Literacy.

Financial Aid Appeals can be obtained in the WPI Office of Student Aid & Financial Literacy or online here.

The appeal will be reviewed by the Financial Aid Appeal Committee. Determination on financial aid appeals will be made on a case by case basis.

1. Regardless of academic progress status, eligibility for WPI financial aid (including the merit scholarship) is available for the shorter of the two following periods: 16 terms (4 years) of enrollment at WPI, as a full time or part-time student, (NOT 16 terms of receiving financial aid), or completion of your Bachelor Degree requirements at WPI.
2. Students must be enrolled full time (minimum of 12 credits per semester) to be eligible for WPI need based and merit based scholarship funding, as well as most federal and state grant programs and work study. A student is considered to be a full time student if they are being charged full time tuition and fees. Students are responsible for knowing their enrollment status and should enroll in the number of credits per year necessary to maintain their aid eligibility.

PLEASE NOTE: With the exception of the Federal Direct Loan, the Federal Pell Grant, and the Global Scholarship - financial aid is not available for enrollment during term E (Summer School) at WPI. This includes all forms of assistance including WPI merit scholarships.

If you enroll during term E, and request to borrow a Federal Direct Loan, the amount you borrow will be based on the student's Federal Direct Loan eligibility within the prior academic year (terms A-D). Federal Pell Grant eligibility will be based on enrollment and eligibility within the prior academic year (terms A-D).

**there are exceptions such as students on an approved reduced course load. Please contact the Office of Student Aid & Financial Literacy if you have concerns.*

INTERNATIONAL STUDENTS

International students (who do not have official documentation of Permanent Residence Status in the United States) are ineligible for all sources of federal and state aid administered by the WPI Office of Student Aid & Financial Literacy. Limited scholarships are available for entering international students through the WPI Office of Student Aid & Financial Literacy.

Alternative Financial Programs

Alternate financing programs are available to many students and their families who do not apply for aid or who need additional resources beyond federal, state, and institutional financial aid offered. WPI offers a payment plan through the Bursar's Office. Learn more here: https://www.wpi.edu/offices/bursar/payment.

There are many long-term financing programs available to assist students and their families in spreading their educational costs over 10 to 20 years. Many of these loans allow students and their families to borrow the difference between the cost of attendance determined by the college and total financial aid received for the academic year.

Please contact the WPI Office of Student Aid & Financial Literacy or visit.

FEDERAL Parent PLUS LOANS

Federal Parent PLUS Loans are available annually to parents of dependent undergraduate students. Repayment begins when the funds are advanced to the school with the option to defer repayment until after the student graduates or falls below half-time enrollment status. Parents have 10 years to repay the Federal PLUS Loan. Learn more here. This loan must be re-applied for each year.

Reserve Officer Training Corps (ROTC) Scholarships

ARMY ROTC SCHOLARSHIP PROGRAM

For information on Army ROTC Scholarships, please contact the Army ROTC office at WPI at (508) 831-5268.

NAVAL ROTC SCHOLARSHIP PROGRAM

For information on Navy ROTC Scholarships, please contact the Naval ROTC Unit at Holy Cross College in Worcester (508) 832-2433.

AIR FORCE ROTC SCHOLARSHIP PROGRAM

For information on Air Force ROTC Scholarships, please contact the WPI Department of Aerospace Studies at WPI at (508) 831-5747.

PLEASE NOTE THE COMBINATION OF ALL SOURCES OF AID CANNOT EXCEED A STUDENT'S BUDGETED COST OF ATTENDANCE.

Awards, Conditions and Notes

As a student receiving merit and/or need-based funding at WPI, students are responsible for reviewing WPI's Award Conditions and Notes document each year to make sure they understand the renewal criteria for the fund(s) in their financial aid offer.

If there are any questions about the information provided in this document, please contact the WPI Office of Student Aid & Financial Literacy at finaid@wpi.edu. The document is updated annually and found here.

Financial Aid Upon Withdrawal/Leave of Absence/Suspension

Students who withdraw, take a leave of absence, or are suspended from WPI and are receiving any type of financial aid should review the policy on Withdrawal or Leave of Absence found here: https://www.wpi.edu/admissions/tuition-aid/policies.

Leaving WPI because of an approved official or unofficial withdrawal, leave of absence or suspension may have an impact on a student's financial aid package. Early notification to the WPI Registrar's Office will help ensure that student's financial aid is appropriately recalculated, and that any required adjustments are made to the student's account as soon as possible.

No classes passed in a term:

If a student who receives federal financial aid fails to earn a passing grade in at least one course during a term (and does not officially withdraw from the institution), federal regulations require WPI to assume that the student has unofficially withdrawn from the institution. WPI must recalculate the student's federal aid eligibility for the semester unless the student can provide documentation from their professors that they completed the term but simply failed to earn a passing grade.

Recalculation of each student's financial aid package will be unique and is dependent on many factors (e.g., time of withdrawal, charges incurred, and financial aid package components); therefore, students are encouraged to contact the WPI Office of Student Aid and Financial Literacy at 508-831-5469, for any questions or concerns.

Expenses

Estimated Expenses

Expenses for the 2022-23 year are published via the web: https://www.wpi.edu/admissions/tuition-aid/cost-attendance.

Tuition	$56,000
Undergraduate Student Life Fee	$316
Health and Wellness Fee	$580
Total of Tuition and Fees	$56,896
New Student Orientation Fee	$200
Room	$9,608
Board (Meal Plan)	$7,062
Books and Supplies	$1,200
Personal Expenses	$1,200
Total Budgeted Costs	$76,166

Room and board (meal plan) amounts shown above are estimates and are determined once the student is assigned a room and chooses a meal plan.

Books and Supplies and Personal Expenses are budgeted Items that are not billed directly by the school but are estimates of what your expenses may be. There may be additional course or program specific fees not listed here.

All full-time students must be covered by health insurance equivalent to that offered under the WPI Student Health Insurance Plan. Students must complete a waiver form online annually if they wish to not purchase the WPI offered plan. Optional coverage for a spouse or dependent is available.
Please contact the Bursar's Office at bursar@wpi.edu or visit our page for further health insurance information.

Part-Time Student

1/3 unit (3 credits) $4,668

Payment of Tuition Deposit

Entering Students

Payment of a nonrefundable $500 deposit is required upon acceptance of admission to WPI. The $500 will be credited to the student's tuition.

Enrollment and Tuition Due Dates

Enrollment for students pursuing a baccalaureate degree will occur three times per year:

1. Fall semester-at the beginning of Term A.
2. Spring semester-at the beginning of Term C.
3. Summer session-at the beginning of Term E.

There will be no check-in at the start of Terms B and D, although a course change period will be available for students continuing from the previous term.

Special tuition features relative to Term E enrollment are available on the E-term website.

WPI sends a notification to the WPI email address assigned to each student when semester charges are available to view. Fall charges are available to view at the beginning of July and Spring charges are available to view at the beginning of December. When viewing your financial account in Workday, you will find an option to print or create a pdf statement for the semester. It is important to view your financial account in Workday frequently for any current changes.

Tuition must be paid in full by the specified due date provided you in the emailed semester notification, which is also found on the semester statement you can create from within your account. Students that register after the due date are required to pay at the time of registration. Students remit payment online with a checking account (no fee) or via credit card (2.85% fee). For international credit card or domestic and international wire payments visit **WPI's Flywire page**. For information on payment options, please visit the **Bursar webpage**.

For E-Term (Summer) charges are available to view in your financial account in Workday at the beginning of April. E-Term typically has two due dates, an E1 due date around second week of May, and an E2 due date around second week of July. If a student registers after either due date, payment is due at the time of registration.

Non-matriculated students, (not enrolled in a WPI degree program) payment is due at the time of registration. Failure to pay will result in being dropped from any course(s).

Financial Obligations, Holds, and Late Fees

*The college reserves the right to hold grades, official transcripts, registration for any student who has an outstanding financial obligation with the college.

Late fees, up to $250, will be assessed on balances not paid by the due date.

A student may be administratively withdrawn due to an outstanding financial obligation for a term, which may require the student to apply for financial re-admission.

Students who elect to petition any charge on their Student Account must do so in writing prior to the final day of classes in the respective term (B term for Fall or D term for Spring). No late petition will be reviewed or approved if submitted after a term has commenced.

Failure to pay your financial obligation may result in the account being referred to an outside collection agency and reported to a credit bureau agency, which will negatively affect your credit rating. You will be responsible for all costs associated with the collection of this debt to the maximum amount allowed by Massachusetts general statutes.

* WPI fully supports the Veterans Benefits and Transition Act of 2018. Sec. 103 amends US code to prevent schools from penalizing Ch. 31 or 33 students if/when the VA is late making payments. WPI policy supports and agrees to the VA recommendations of the following while waiting for VA payments: WPI agrees to not prevent enrollment, charge a late penalty fee(s), require alternative or additional sources of funding or deny access to school resources.

Overload Charges

There will be a tuition surcharge on registration which contains academic overloads in excess of $2^1/_3$ (7/3) units per semester. Wellness and Physical Education and Military Science are not included in the determination of overloads. The overload charge will be based upon the total registration credit held by the student at the close of the initial course change period in B- and D-terms. (Please consult the Registrar's Office or the Office of the Bursar for current fees.) Fall overload billing will take place during Term B and spring overload billing during Term D. The current Term E charge system will not be affected.

Tuition Adjustment Charges Upon Withdrawal, Leave of Absence, or Suspension

Tuition adjustment charges upon formal withdrawal from the college during each semester are:

Charge

Withdrawal	Charge
Withdrawal after enrollment but prior to first day of classes of a semester	0%
Withdrawal weeks 1 & 2	10%
Withdrawal week 3	20%
Withdrawal week 4	30%
Withdrawal week 5	40%
Withdrawal week 6-8	50%
Withdrawal week 9	60%
Withdrawal week 10	80%
Withdrawal week 11 and after	100%

To qualify for a tuition charge adjustment, students must submit an Official Withdrawal form to the Registrar's Office. The date of the student's last date of attendance determines the charge.

There is no adjustment in tuition/fees in the case of withdrawal from individual courses.

Students who have paid full tuition for eight semesters may be allowed to enroll as part-time students on a per-course basis and be charged tuition accordingly. (Two summer terms enrolled as a full-time student may be counted as a semester.) Students must submit the Application for Part-time Status to the Registrar's Office at least two weeks before the beginning of the fall or spring semester.

Health insurance, health fee, and social fee are neither pro-rated nor refunded.

After all adjustments have been made, any balance due to WPI is payable immediately.

Room & Board Charges Upon Withdrawal, Leave of Absence, or Suspension

Charge

Withdrawal	Charge
Withdrawal after enrollment but prior to first day of classes of a semester	0%
Withdrawal weeks 1 & 2	10%
Withdrawal week 3	20%
Withdrawal week 4	30%
Withdrawal week 5	40%
Withdrawal week 6-8	50%
Withdrawal week 9	60%
Withdrawal week 10	80%
Withdrawal week 11 and after	100%

Financial Aid Upon Withdrawal/Leave of Absence/Suspension

Housing

Residence Halls

WPI provides its undergraduate students with a variety of housing options. The WPI residence halls offer first year students housing in double and triple occupancy rooms as well as suites designed for four to eight people. A limited number of singles for students with documented need through the Office of Accessibility Services are available. (Residence hall living at WPI offers opportunities that can be a valuable part of higher education.)

First-year students admitted for Term A, who meet all application deadlines, are guaranteed housing in the residence halls for that entire academic year. The Housing & Residential Experience Center works to maximize the opportunities available for upper-level housing. Some options include townhouses, apartments, and residential houses. Off campus housing alternatives include rooms in homes, apartments and commuting from home. Additionally, for fraternity and sorority members there is Greek chapter housing available. Upper-level students are not guaranteed on-campus housing. The Housing and Dining Contract is a legally binding contract which extends from the beginning of Term A through Term D as long as the student is enrolled at WPI.

Residence Hall Staff

Resident Advisors (RAs) and Graduate Housing Assistants (GHAs) are the core of the residential life staff in the residence halls. RAs serve as a source of assistance in resolving students' academic, personal, and social concerns. They plan and implement social and educational programs in the halls and enforce all WPI policies and regulations in an effort to develop an effective residential community in the residence halls. The administrative responsibility for the operation of the residence halls rests with the professional staff in the Housing & Residential Experience Center, specifically the Community Directors (CDs) who supervise and work with the RAs and GHAs. They counsel and advise students, work with maintenance and dining hall staffs, and handle many administrative processes for students living on campus.

Occupancy

Opening and closing dates of the residence halls are posted on the Housing & Residential Experience Center website as they are determined. Students will also receive email communication with move in information ahead of each process. Housing and food service privileges are not transferable, nor may any person take up de facto residence without paying rent. The traditional residence halls will be closed during the Winter Break period.

Furnishings and Facilities

Students are responsible for the neatness and cleanliness of their rooms. Residence halls are furnished with a twin-size bed, a desk and chair, closet space, and drawer space for each student. All residence halls are smoke-free environments. Data network services and a movie streaming service are included in room rates. Residents provide their own pillows, linens, blankets, and other personal furnishings.

Mobile pay laundry facilities are available on the campus.

The following are some things not permitted in the residence halls:

- Sale, use or possession of illegal drugs
- Pets, except small fish
- Refrigerators larger than 4.3 cubic feet in size, 3D printers
- Gambling
- Use of alcoholic beverages in violation of Massachusetts State Laws
- Firearms, weapons, explosives, incendiary or toxic chemicals, starting pistols, paint ball guns, knives
- Cooking, except in kitchen areas provided
- Candles or other flame-emitting devices
- Smoking of any kind

For a complete copy of the housing and dining contract, please visit the WPI website.

Mail & Packages

Mail and express packages should be addressed to the student by name, and box number, WPI, 100 Institute Road, Worcester, MA 01609-2280. Please visit the Mail Services website https://www.wpi.edu/offices/mail-services for more detailed information.

Roommates

One of the most memorable aspects of campus life can be the relationship you will build with your roommate(s). Roommates often find that a meaningful relationship is developed through good communication. We encourage you to be as open as possible so that you and your roommate can begin early to create a relationship based on respect and understanding. This relationship can help make residence hall living one of the most enjoyable part of your college career.

Room Charges

Room Rates can be found by CLICKING HERE (*Note: Room rates are shown for the entire academic year or per semester*)

First Year Residence Halls & Houses:

Daniels, Founders, Institute, Messenger, Morgan, Riley, Stoddard, Trowbridge House, Wachusett House, and WPI Townhouses.

Upper-level Apartments & Houses:

East, Elbridge House, Ellsworth, Faraday, Fuller, Hackfeld House, Schussler House, South Village (Cedar A House, Cedar B House, Fruit House, Marston A House, Marston B House, Oak House, Sever House, West House, and William House) and WPI Townhouses.

Payment for housing and food service fees are made in two installments, one each at the beginning of Terms A and C. Reduced charges, if applicable, will be processed according to the established withdrawal policy of the college. Students entering the residence halls other than at the beginning of Term A or C will be issued a prorated billing for the period. This bill must be paid in full prior to occupancy.

Students are expected to care for the physical facilities of the residence halls. Damage to the facilities beyond the normal wear and tear shall be the financial responsibility of the residents. Damage to common areas of the residence halls will be divided among residents of that wing, floor, or building.

First year students can expect to receive a link to the Housing Portal in May, after their $500 tuition deposit is received by the Office of Admissions. First Year students should be prepared to select their housing through the online housing selection portal in early to mid-July.

Meals

All first-year students and upper-level students residing in South Village are required to participate in a residential meal plan. All other students are welcome to purchase a meal plan as well. The MEAL PLANS are a combination of traditional meal swipes plus additional funds to be utilized at the student's discretion.

Once a student has contracted for food service, this is a legally-binding agreement, and students are obligated to assume financial responsibility for the entire academic year.

Board Plan Rates can be found by CLICKING HERE (*Note: Board plan rates are shown for the entire academic year or per semester*)

(Note: Students are required to be on a meal plan for the entire academic year)

Descriptions of the board plans are available at:
http://www.dineoncampus.com/wpi

Off-Campus Living

After the first year, on-campus housing is not guaranteed. If you decide to look for an off-campus apartment, make plans well in advance. Information is available on the WPI website for you to research questions about housing codes, leases, tenants' rights, etc. The following are a few hints for you as you begin your search for off-campus housing.

Leases: Contract periods for off-campus housing vary in length, from twelve-month and nine-month to summer only and three-month leases. As you consider various places, find out what types of leases are available.

Be Prepared: You'll want to plan realistically for expenses such as utilities, transportation, repairs, laundry, and food. Also, try to pick your roommates carefully and ahead of time.

Lodging Laws

You should also be aware that the City of Worcester has a zoning code that prohibits more than three unrelated persons living together unless the landlord or owner has obtained a lodging house license.

Policies & Procedures

Academic Policy

Grading Policies

Distribution of Grades

Academic grades of undergraduate students may be released to parent(s) of a student claimed as a dependent for tax purposes. WPI presumes that all undergraduate students are dependents of their parent(s) unless they file a Declaration of Independent Status petition form with the Registrar's Office. These forms are available in the Registrar's Office. After the Registrar's Office receives a Declaration of Independent Status petition form from an undergraduate student, the Office will not release the student's academic grades to the parent(s) of such student until such time as the student rescinds their Declaration, in writing filed with the Registrar's Office, or his/her parent(s) provide acceptable proof of tax-dependent status to the Registrar's Office. The Registrar's Office will keep a record of any release of grades directly to the parent(s) of a dependent student in that student's record, and the student will be able to review that record.

Grading System

Projects: The following term grades are possible: A, B, C, SP (Satisfactory Progress), NAC (Not Acceptable) and NR (No record).

Courses: The following grades are possible: A, B, C, NR, and I (Incomplete). An instructor may also assign an "I" in an Independent Study course. AT (attended) is used to denote participation in seminars or college-sponsored programs. If an undergraduate student repeats a course previously graded with an A, B or C, both grades will appear on the undergraduate student transcript with the lower grade marked with a '/R' indicating a repeated class. Only the higher grade will be used to calculate the student's numerical equivalent.

Students such as Consortium (CO), nondegree-seeking students, and Graduate students will receive traditional A, B, C, D, F, Withdrawal and Pass/Fail grades.

Grades for Completion of Degree Requirements

The overall evaluation of degree requirements (for the MQP, the IQP and the Humanities and Arts Requirement) will be graded in the student's respective grade system. The transcript will contain an abstract describing the content of the completed project.

No Record (NR)

The NR (No Record) grade is assigned by a faculty member for course or project work for which credit has not been earned. This grade applies to PLAN students (admitted, degree-seeking) only. The NR grade does not appear on the students' transcripts or grade reports.

Incomplete (I)

An I grade, when assigned, will be changed to NR after one term unless extended in writing by the instructor to the Registrar's Office. The I grade is not assigned for Qualifying Projects.

Satisfactory Progress (SP)

In project work (IQP, MQP only) extending beyond one term for which a grade is not yet assigned, an interim grade of SP (Satisfactory Progress) may be used on grade sheets. In such cases, the SP evaluation will count as units earned toward meeting the 15-unit rule, the distribution requirements, and the minimum standards for satisfactory academic progress. SP grades remain on the transcript until changed to the final grade as submitted on the Completion of Degree Requirement Form or through the grade change form procedure.

Other Grades

A ? or Q signifies a grade that has not been submitted.

Qualifying Project Grading

The Faculty of WPI has endorsed the following grading guidelines for qualifying project activity:

1. Each term a student is registered for a qualifying project, the student receives a term grade reflecting assessment of his or her accomplishments for that term.
2. Upon completion of a project, each student will receive an overall project grade (also known as the "CDR grade," since it certifies completion of the degree requirement) reflecting his or her individual overall accomplishments for the project.
3. The term grades and the overall project grade reflect both the *products* of the project (e.g., results, reports, etc.) and also the *process* by which they were attained. The term grades and the overall project grade may be different.

The following are some characteristics that faculty should use in communicating expectations and evaluating the quality of each student's project work.

The degree to which the student:

- developed effective or creative goals or approaches,
- demonstrated initiative and originality,
- showed depth and critical thought in analysis,
- produced high quality results,
- took the lead in discussion, planning, and analysis,
- produced a clear, professional-level report with excellent drafts along the way,
- anticipated work that needed to be done and completed it in a timely manner, and
- worked to advance the success of the team.

For both terms and overall project, the available grades and interpretations are:

A: This grade denotes *excellent work* that attains all of the project goals and learning outcomes. The product and process of this work meet all of the expectations and exceed them in several areas.

B: This grade denotes *consistently good work* that attains the project goals and learning outcomes. The product and process of this work meet but generally do not exceed all of the expectations.

C: This grade denotes *acceptable work* that partially attains project goals and learning outcomes. The product and process of this work meet some but not all expectations.

SP: This grade denotes *satisfactory progress* and certifies sufficient accomplishments to earn credit for that term. Faculty who assign this grade should provide clear feedback to the student regarding his or her progress during the term. The use of the SP grade is discouraged except in circumstances where the faculty member is unable to judge the quality of the work, yet can attest that the granting of credit is appropriate. This is a temporary grade and must be replaced by a permanent grade consistent with the criteria outlined above by, if not before, the end of the project.

NR: This grade denotes work that did not attain the project goals or learning outcomes and is *insufficient for registered credit*. Both product and process were inconsistent with acceptable project work at WPI as outlined above.

NAC: This grade is reserved for *performance that is unacceptable*. It might mean that a student's performance (or lack of it) has seriously impeded group progress, or it has embarrassed the group, a project sponsor, or WPI. Note that this grade remains on the transcript.

4. Project goals should be established and clearly articulated early in the project. This may be done in the form of a formal project proposal. Learning outcomes for the qualifying projects have been established by the faculty and are published in the undergraduate catalog.

5. Project advisors should clearly convey in writing their expectations for learning and performance to project students at the start of the project, and provide students with substantive feedback on a regular basis during the project.

Cumulative Grade Point Average

WPI does not maintain a Cumulative Grade Point Average for undergraduate students. A student who needs a cumulative point average for external use may apply to the Registrar and receive a numerical equivalent. This information is usually provided only for students applying to graduate or professional schools when the application process requires a translation. Cumulative point averages will not be printed on student's transcripts nor shall class rankings be developed from them.

When requested by the student, the numerical equivalent of the cumulative point average will be based on a point assignment of A = 4.0, B = 3.0, C = 2.0 while DIST and AC grades will be 4.0 and 2.75 respectively.

Dean's List

The Dean's List is created and published twice a year: in January to review student work completed during the AB terms and in May to review student work completed during the CD terms. To be named to the Dean's List a student must:

Complete 4/3 units with grades of A's, and at least an additional 2/3 units with grades of B or above.

For example, a student with 4A's, 2B's and 1C (or 1 NR) in 1/3-unit courses during a semester is eligible for the Dean's List. Credits earned in Wellness and Physical Education, Military Science, and Air Force Aerospace Studies are not used in the evaluation for the Dean's List. For the purposes of determining the Dean's List only, an SP grade for project work will be considered a B grade. The Dean's List recognizes outstanding work completed during the most recent semester. Student requests to re-evaluate their eligibility for the Dean's List due to a grade change after the semester review is completed will be considered only in unusual circumstances and at the discretion of the Dean of Undergraduate Studies.

Grade Appeal and Grade Change Policy

The purpose of the Grade Appeal Policy is to provide the student with a safeguard against receiving an unfair final grade, while respecting the academic responsibility of the instructor. Thus, this procedure recognizes that,

- Every student has a right to receive a grade assigned upon a fair and unprejudiced evaluation based on a method that is neither arbitrary nor capricious; and,
- Instructors have the right to assign a grade based on any method that is professionally acceptable, submitted in writing to all students, and applied equally.

Instructors have the responsibility to provide careful evaluation and timely assignment of appropriate grades. Course and project grading methods should be explained to students at the beginning of the term. WPI presumes that the judgment of the instructor of record is authoritative, and the final grades assigned are correct.

A grade appeal shall be confined to charges of unfair action toward an individual student and may not involve a challenge of an instructor's grading standard. A student has a right to expect thoughtful and clearly defined approaches to course and project grading, but it must be recognized that varied standards and individual approaches to grading are valid. The grade appeal considers whether a grade was determined in a fair and appropriate manner; it does not attempt to grade or re-grade individual assignments or projects. It is incumbent on the student to substantiate the claim that his or her final grade represents unfair treatment, compared to the standard applied to other students. Only the final grade in a course or project may be appealed. In the absence of compelling reasons, such as clerical error, prejudice, or capriciousness, the grade assigned by the instructor of record is to be considered final.

In a grade appeal, only arbitrariness, prejudice, and/or error will be considered as legitimate grounds for an appeal.

Arbitrariness: The grade awarded represents such a substantial departure from accepted academic norms as to demonstrate that the instructor did not actually exercise professional judgment.

Prejudice: The grade awarded was motivated by ill will, and is not indicative of the student's academic performance.

Error: The instructor made a mistake in fact.

This grade appeal procedure applies only when a student initiates a grade appeal and not when the instructor decides to change a grade on his or her own initiative. This procedure does not cover instances where students have been assigned grades based on academic dishonesty or academic misconduct, which are included in WPI's Academic Honesty Policy. Also excluded from this procedure are grade appeals alleging discrimination, harassment or retaliation in violation of WPI's Sexual Harass- ment Policy, which shall be referred to the appropriate office at WPI as required by law and by WPI policy.

The Grade Appeal Procedure strives to resolve a disagreement between student and instructor concerning the assignment of a grade in an expeditious and collegial manner. The intent is to provide a mechanism for the informal discussion of differences of opinion, and for the formal adjudication by faculty only when necessary. In all instances, students who believe that an appropriate grade has not been assigned must first seek to resolve the matter informally with the instructor of record. If the matter cannot be resolved informally, the student must present his or her case to the Faculty Review Committee before the end of the second week of the term after the disputed grade is received (D term grades may be appealed the following A term). Any exceptions to this deadline for submission of appeal can only be made by the Office of the Provost.

Student Grade Appeal Procedure

1. A student who wishes to question a grade must discuss the matter first with the instructor of record within one week after the start of the next regular academic term (A – D) after receiving the grade. Late appeals will only be reviewed at the discretion of the Faculty Review Committee (FRC). In most cases, the discussion between the student and the instructor should suffice and the matter will not need to be carried further. The student should be aware that the only valid basis for grade appeal beyond Step One is to establish that an instructor assigned a grade that was arbitrary, prejudiced, or in error.
2. If the student's concerns remain unresolved after the discussion with the instructor, the student may submit a written request to meet with the appropriate Department Head, within one week of speaking with the instructor. For a grade in a course, independent study, Inquiry Seminar or Practicum, or Major Qualifying Project (MQP), the appropriate person is the instructor's Department Head. For a grade in an Interactive Qualifying Project (IQP), the appropriate person is the Dean of the Department of Integrated and Global Studies (DIGS). If the instructor of record is a Department Head or the Dean of the DIGS, then the student should request to meet with the representative from the Provost's office (the Dean of Undergraduate Studies, or alternative if necessary), who will serve as the appropriate Department Head/Dean in this step. The appropriate Department Head/Dean will meet within one week with the student, and, if he or she believes that the complaint may have merit, with the instructor. After consultation with the Department

Head/Dean, the instructor may choose to let the grade remain, to change a course grade, or to petition the Committee on Academic Operations to change a grade for a Degree Requirement (CDR grade for MQP, IQP, or Humanities and Arts Inquiry Seminar or Practicum). The Department Head/Dean will communicate the result of these discussions to the student.

3. If the matter remains unresolved after Step Two, the student should submit a written request within one week to the Provost's Office to request an ad hoc Faculty Committee for Appeal of a Grade. The Provost's representative (the Dean of Undergraduate Studies, or alternate) will meet with the student, and will ask the FRC to appoint the ad hoc Committee for Appeal of a Grade. The Chair of the FRC will select the members of the ad hoc committee and serve as its non-voting chair. The ad hoc committee for all undergraduate appeals will be composed of three FRC members. Appointees to the ad hoc committee must not have any apparent conflicts of interest with the student or instructor of record. The Chair of the FRC requests a written statement from the student and a written response from the instructor. The ad hoc committee examines the written information and may gather additional information as it sees fit.
4. Through its inquiries and deliberations, the ad hoc committee is charged to determine whether the grade was assigned in a fair and appropriate manner, or whether clear and convincing evidence of arbitrariness, prejudice, and/or error might justify changing the grade. The ad hoc committee will make its decisions based on a majority vote.
5. If the ad hoc committee concludes that the grade was assigned in a fair and appropriate manner, the ad hoc committee will report its conclusion in writing to the student and instructor. This decision of the ad hoc committee is final and not subject to appeal.
6. If the ad hoc faculty committee determines that compelling reasons exist for changing the grade, it would request that the instructor make the change, providing the instructor with a written explanation of its reasons. At this point, the instructor may change the grade. If the instructor declines to change the grade, he or she must provide a written explanation for refusing. If the ad hoc faculty committee concludes that the instructor's written explanation justifies the original grade, the ad hoc committee will report this in writing to the student and instructor and the matter will be closed. If the ad hoc faculty committee concludes that it would be unjust to allow the original grade to stand, the ad hoc committee will then determine what grade is to be assigned. The new grade may be higher than, the same as, or lower than the original grade. Having made this determination, the three members of the committee will sign the grade change form and transmit it to the Registrar. The instructor and student will be advised of the new grade. Under no circumstances may persons other than the original faculty member or the review committee change a grade. The written records of these proceedings will be filed in the student's file in the Registrar's Office.

Faculty Grade Change Procedure

The Student Grade Appeal Procedure affirms the principle that grades should be considered final. The principle that grades for courses or projects should be considered final does not excuse an instructor from the responsibility to explain his or her grading standards to students and to assign grades in a fair and appropriate manner. The appeal procedure also provides an instructor with the opportunity to change a grade for a course or project on his or her own initiative. The appeal procedure recognizes that errors can be made and that an instructor who decides that it would be unfair to allow a final grade to stand due to error, prejudice or arbitrariness may request a change of grade for a course or project without the formation of an *ad hoc* committee. An instructor may request a grade change in one of two ways. First, for courses, an instructor may submit a course grade change via Workday to the Registrar at any time prior to a student's graduation. Second, for Degree Requirements (MQP, IQP), an instructor must submit a petition to the Committee on Academic Operations (CAO) to change the grade.

Transfer Credits

Transferring Credit Before Matriculation to WPI

The Office of Admissions transfer admissions team coordinates the formal evaluation of credit with evaluators in each academic department for a WPI degree for coursework taken prior to matriculation. For incoming first year students, this process starts after the May 1st enrollment deadline for the upcoming fall semester. For transfer students, this starts after admission to the university. More information is available at www.wpi.edu/+transfercredit. Each WPI academic department has their own policy regarding transfer credit and designates a faculty evaluator to review coursework submitted. Courses taken at regionally accredited post-secondary institutions that are comparable to courses offered at WPI will be reviewed for course content and level by the WPI academic department offering the comparable course. In general, only those courses in which the student received a grade of C or better will be evaluated for possible transfer credit, with some department requiring a grade of B or better. Please note vocational, correspondence, pre-college or review courses are not transferable. Also, noncredit CEU courses, adult enrichment or refresher courses, and CLEP examinations are not recognized for transfer credit.

Transferring Credit After Matriculation to WPI

If you are currently a WPI student who wishes to take courses at a regionally accredited post-secondary institution, you must obtain a WPI Transfer Credit Authorization form from the Registrar's Office. This form and the course description must be taken to the WPI department head or transfer faculty approved by the department head for approval **before** the course is taken. On the form, the department head specifies a minimum grade for transfer. This minimum grade depends on the institution at which the course is taken and how critical the course is to the department. Please note, most departments do **not** accept on-line courses for transfer credit. Confirm this with the relevant department before registering and completing any on-line courses. Courses that have not been pre-approved may not receive transfer credit. The completed form must be filed in the Registrar's Office before taking the course. After successful completion of the course, an official transcript should be sent to WPI. Students can check the web for posting of credit. Please note vocational, correspondence, pre-college or review courses are not transferable. Also, noncredit CEU courses, adult enrichment or refresher courses, and CLEP examinations are not recognized for transfer credit.

Transferring Consortium Courses

Courses taken through the consortium do not need to be transferred into WPI. Courses will automatically be part of the WPI transcript. However, if you are taking the course through the consortium to fulfill a WPI distribution requirement, you should check with the Registrar's Office to see if the course has been pre-approved to satisfy the requirement. If not, you will need approval from the relevant department head before taking the course.

To apply for approval of a consortium course to satisfy a specific WPI distribution requirement, a student must obtain a WPI Transfer Credit Authorization form from the Registrar's Office. This form and the course description must be taken to the WPI department head for approval before the course is taken. The WPI department head decides whether the proposed course meets the department distribution requirement. If it does, the department head specifies on the form a minimum grade for satisfying the distribution requirement. This minimum grade depends on the institution at which the course is taken and how critical the course is within the department. Courses that have not been pre-approved may receive WPI elective credit. The complete form must be filed in the Registrar's Office before taking the course.

Advanced Placement

WPI awards credit to students who score a "4" or "5" on most Advanced Placement Examinations. The Office of Academic Advising will notify such students of their earned credit by mail to the home address during early August. You can visit the Registrar's Office web site www.wpi.edu/offices/registrar/policies-procedures/ap-credit for a complete list of AP credits for exams taken.

Humanities

The Humanities and Arts Department will accept a maximum of 1/3 unit of AP credit towards the Humanities and Arts requirement. AP credit beyond one course (1/3 unit) in the Humanities and Arts may be counted toward other requirements such as free elective credit or particular majors and minors at WPI. For most humanities disciplines, students who score a 4 or 5 in the AP test will receive credit in the relevant discipline. Special cases in language and studio art are explained below.

AP credit in languages

Students who score a 4 or higher on the College Board AP exam in Chinese language and culture, German Language, Spanish language, or Spanish literature, automatically receive 1/3 unit of credit in the language. This can be applied to the breadth component of the HUA Requirement or to the HUA language track option. In either case, the student will receive credit for one of the following Elementary 1000-level language courses and cannot enroll in that course for additional credit: CN 1541, GN 1511, SP 1523.

Students who took Arabic, Chinese, German, or Spanish in high school – but who do not earn AP credit for it at WPI – can get 1/3 unit retroactive credit for that language if they meet the following 3 criteria: 1) studied it for three or more years in high school and maintained at least a B average for all three years and; 2) place into at least the 2nd term of the appropriate WPI language sequence; and 3) successfully complete two terms of that language at WPI, earning grades of B or higher in both courses. The exception is Spanish: students studying Spanish must complete Intermediate I (SP 2521) and Intermediate II (SP 2522) with a grade B or higher. To request 1/3 unit retroactive language credit, please use the appropriate form on the Humanities and Arts website (https://www.wpi.edu/academics/departments/humanities-arts/resources). Students may receive credit for either the AP exam or 3 years of high school language study, but not both. For questions about this policy, please contact the Humanities and Arts Department.

AP Credit in Studio Art

Students who score a 4 or 5 in the AP test in studio art are eligible for HUA credit after a successful portfolio review by art faculty.

Computer Science

Advanced placement in computer science can be earned for the "Computer Science AP A" exam. Credit for CS 1000 is granted for scoring a "4" or "5" on the CS AP A exam. No credit will be granted for "Computer Science AP Principles" exam.

The Computer Science department advises CS Majors who earn a "4" or a "5" on the CS AP A exam to enroll in CS 1102 (Accelerated Introduction to Program Design). Students who wish to pursue a CS Minor after earning a "4" or a "5" on the CS AP A exam may consider enrolling in CS 2119 (Application Building with Object-Oriented Concepts) or CS 2301 (Systems Programming for Non-Majors).

Students who took CS AP Principles exam and have substantial programming experience should consult with the CS course instructors as to which course to take.

Natural Sciences

Students who pass the advanced placement test in Biology or Physics B with a "4 or 5" will be awarded 1/3 unit of advanced placement credit. This credit will show on the transcript as "L". For students who score "4 or 5" in Physics C (Mechanics) will be awarded 1/3 unit in Physics 1110/ 1111. Students who score "4 or 5" in Physics C (Electricity and Magnetism) will be awarded 1/3 advanced placement credit for Physics 1120/1121. For those students who pass Physics B will be awarded 1/3 unit in Physics 1000. Students who score 4/5 on the Chemistry Advanced Placement Examination or 6/7 on the Chemistry International Baccalaureate Exam are automatically awarded 1/3 unit of credit for CH 1010.

Mathematics

Students who pass the AB mathematics examination with a "4" or "5" will be awarded 2/3 unit of advanced placement credit for MA 1021 and MA 1022. Students with a "4" or "5" on the advanced placement BC exam will be awarded 1 unit advanced placement credit for MA 1021, MA 1022 and MA 1023. Retroactive AP credit is only possible for MA 1021 and/or MA 1022 via the following pathways. In the four-course 1021-1024 mathematics sequence, students who arrive at WPI prepared to start with the second (or third) course in the WPI sequence, and who successfully pass that course and the one that follows it, will be considered to have established advanced placement credit for the first one (or two) courses. Retroactive AP credit is awarded for MA 1021 and MA 1022 if a student arrives at WPI prepared to take MA 1024 and successfully passes that course and MA 2051. To qualify for retroactive credit, the two WPI courses must be passed on the first attempt by D-term of the student's first year and the student must have no grades of NR in any course in the MA 1021-1024 sequence in the first year. The courses credited retroactively will be listed by number without an assigned grade and will count toward the distribution requirement in mathematics.

Project Lead The Way (PLTW)

WPI awards credit to current WPI students who completed a PLTW Engineering course in high school, received a minimum of a “B” in the course, and earned on the PLTW End-of-Course Assessment either a stanine score of 6 or higher (before July 2018) or a minimum scale score of 410 for IED, 410 for POE, 420 for CEA, 430 for CIM, 450 for DE. WPI also honors PLTW transfer credits from other select PLTW university partners, such as RIT. Please visit the WPI Project Lead The Way web site (www.wpi.edu/+pltw) for more information and to apply for credit. A staff member will notify students of their earned credit..

Academic Honesty Policy

Academic honesty is a fundamental principle of learning and a necessary foundation for all academic institutions, particularly those dedicated to independent project-based education, such as WPI. Violations of the principle deny the violators an opportunity to obtain confident command of the material they are credited with knowing, cheat their classmates out of deserved rewards and recognition, debase the institution, and demean the degree that it awards. It is, therefore, a matter of great and mutual concern to all members of the WPI community that a concerted effort be made to maintain high standards of integrity, both to protect the value of the educational process in which we are engaged and to maintain the credibility of the institution.

Definition

Individual integrity is vital to the academic environment because education involves the search for and acquisition of knowledge and understanding, which are, in themselves, intangible. Evaluation of each student’s level of knowledge and understanding is a vital part of the teaching process, and requires tangible measures such as reports, examinations, and homework. Any act that interferes with the process of evaluation by misrepresentation of the relation between the work being evaluated (or the resulting evaluation) and the student’s actual state of knowledge is an act of academic dishonesty. The following acts are examples of academic dishonesty at WPI:

Fabrication

Examples:

- Altering grades or other official records
- Changing exam solutions after the fact
- Inventing or changing laboratory data
- Falsifying research
- Inventing sources
- Sabotage of another student’s work or academic record

Plagiarism

Examples:

- Misrepresenting the work of another as one’s own
- Inaccurately or inadequately citing sources including those from the Internet

Cheating

Examples:

- Use of purchased term papers
- Copying on exams, homework, or take-home exams
- Use of unauthorized materials or sources of information such as "cheat sheet," pre-programmed calculator
- Assistance of another person in cases where prohibited

Facilitation

Examples:

- Sharing test questions or answers from an exam with another student
- Letting another student copy a solution to a homework problem, exam, or lab
- Taking an exam for another student
- Assistance in any act of academic dishonesty of another student

Responsibilities of Faculty Members and Students

Faculty members should outline their policies concerning evaluation procedures and their expectations pertaining to academic integrity at the beginning of each course. Faculty must ensure that student performance is judged solely on the basis of academic work in courses and projects. Because of the differences in disciplines and the type of work involved, faculty interpretation regarding what constitutes academic dishonesty may vary across campus. Since project-based education places a strong emphasis on group work, faculty and students should be particularly attentive to the distinction between group work and individual performance expectations. Faculty and students are responsible for knowing and understanding WPI's policy and procedure for dealing with academic dishonesty. Faculty are encouraged to implement measures designed to minimize or prevent academic dishonesty.

Procedures

The WPI faculty and administration have developed a set of procedures designed to ensure uniform (and fair) treatment of undergraduate or graduate students suspected of academic dishonesty. Students or others who suspect a faculty member of professional dishonesty should consult the academic department head or the provost.

- Faculty shall report to the department chair any suspected act of academic dishonesty.
- The chair shall review cases referred to him/her to determine if there is reason for believing that academic dishonesty may be involved.
- Faculty shall allow the student to continue in the course without prejudice, pending resolution of the case.
- The chair or instructor shall check with the dean or associate dean of students to determine if the student has any record of prior offenses involving academic dishonesty.
- The chair or instructor shall consult with the student involved. If the act of academic dishonesty is admitted and is the first violation of that nature, the chair or instructor may resolve the complaint within the department, provided the penalty is accepted by the student in writing. The maximum penalty that can be applied at the department level is dismissal from a course or a project without credit. In all cases, a signed, written report on the matter, including the action taken, shall be sent to the Dean of Students Office and to the student's Academic Advisor.
- For the second and subsequent violations, the case shall be submitted to the Campus Hearing Board for resolution.
- The Campus Hearing Board shall hear the allegations, following standard procedures for disciplinary hearings established by WPI. The board may impose normal disciplinary sanctions and may recommend loss of any credit or grade for the course or project. If a student is found not responsible on a complaint of academic dishonesty, he/she may not be failed or penalized by the instructor on the grounds of dishonesty. The instructor shall assign a grade based on his or her assessment of the student's mastery of the material being evaluated.
- Disciplinary records for any act of academic dishonesty shall be retained in the Dean of Students Office for two years from the date of graduation or withdrawal from WPI, except when the sanction includes suspension or expulsion. In cases resulting in suspension or expulsion from WPI, disciplinary records shall be kept in perpetuity. Records for cases that are pending completion of the hearing and/or the sanction shall be kept in perpetuity. Judicial records are kept separate from a student's academic records. A student's judicial record may be shared internally as appropriate to determine if a past record exists. Records shall be available to prospective employers and other authorized individuals, in accordance with federal regulations that require written permission from the student involved.

Commencement Policy

The policy for allowing certain undergraduate students who have not completed all degree requirements to participate in Commencement exercises is:

1. Undergraduate students who have not met all degree requirements will be eligible to participate in Commencement exercises only if *all of the following* are true:
    1. At the end of D term, the student is within 1 unit of completing all requirements for graduation.
    2. The student has completed at least 2 of the 3 WPI Project Requirements (Humanities and Arts Requirement, IQP, and MQP).
2. Undergraduate students who meet these conditions will be permitted to participate in Commencement exercises but will not receive their diploma. The names of such students will **not** be included in the Commencement program. The actual degree will be conferred only after all degree requirements have been completed. The student will not be eligible to participate in any future commencement ceremonies for this degree.
3. There are no exceptions to this policy.

Graduation with Honors

For all degree candidate students graduating from WPI after May 1, 2011, graduation honors will be determined as follows:

Graduation With High Distinction

An *A* grade on all *four* of the following:

- MQP
- IQP
- Inquiry Seminar/Practicum
- Eight units (24/3 units) of work registered at WPI (exclusive of PE and of the MQP, IQP and the Inquiry Seminar/Practicum component of the Humanities and Arts Requirement).

Graduation With Distinction

A grade of *A* on the following criteria:

- MQP
- IQP
- Inquiry Seminar/Practicum
- Four units (12/3 units) of work registered at WPI (exclusive of PE and of the MQP, IQP and the Inquiry Seminar/Practicum component of the Humanities and Arts Requirement).

or

A grade of *A* on the following criteria:

- Two of the three projects: MQP, IQP and the Inquiry Seminar/Practicum
- Six units (18/3 units) of work registered at WPI (exclusive of PE and of the MQP, IQP and the Inquiry Seminar/Practicum component of the Humanities and Arts Requirement).

Honors for Double Majors

If a student completes two majors, the student is awarded a degree with “Distinction” or “High Distinction” if the student meets the criteria above in either or both majors; if both awards are received, the degree is awarded with “High Distinction.”

Awards and Prizes

Awards and prizes are determined by the academic department or by selected committees.

College Awards

SALISBURY PRIZE AWARDS

These historic awards are made to highly meritorious seniors. These awards were established by Stephen Salisbury, a WPI founder and former president of the Board of Trustees.

TWO TOWERS PRIZE

This prize is awarded to the student who, through general academic competence, campus leadership, regular course work and special work in research and projects, best exemplifies a combined proficiency in the theoretical and practical union implicit in the Two Towers concept, which is at the heart of WPI's Two Towers tradition.

SIGMA XI AWARDS IN ENGINEERING AND SCIENCE

These awards in engineering and science are given to the students and their advisors for the Major Qualifying Projects which are judged to be the best in originality, contribution to the field, professional competence, and for the most useful applications.

PRESIDENT'S IQP AWARDS

These awards are given to student teams whose conception, performance, and presentation of their Interactive Qualifying Projects have been judged outstanding in focusing on the relationships among science, technology, and the needs of society.

PROVOST'S MQP AWARDS

These awards offer recognition to those students who have completed outstanding Major Qualifying Projects as a demonstration of their competency in a chosen academic discipline. Each academic department conducts its own competition to select the winners.

CLASS OF 1879 AWARD

Endowed by the Class of 1879, this prize is awarded by the Humanities and Arts Department yearly for excellent work in the culminating project for the Humanities and Arts Requirement. Projects must demonstrate exceptional creativity and skill in conceiving, developing, and expressing a theme within any discipline within the humanities and arts.

OUTSTANDING WOMEN STUDENT AWARDS

Marietta E. Anderson Award, an award which is presented to the most outstanding woman student in one of the three lower classes who not only has a superior academic record, but also has been a work-study student, participated in recognized extracurricular activities, and has been a volunteer for college-sponsored activities.

Funds from an anonymous donor provide the following awards to women students preparing for careers in engineering or science. Awards are based on academic excellence, contributions to the WPI community, and professional goals. The awards are named each year for women who have played significant roles at WPI.

Bonnie-Blanche Schoonover Award, honoring WPI's former librarian.

Ellen Knott Award, honoring a long-time secretary in the Mechanical Engineering Department.

Gertrude R. Rugg Award, honoring WPI's late Registrar Emerita.

Wilmer l. and Margaret M. Kranich Prize

Students who are seniors or completing their junior year will be nominated by faculty for the annual award. The award will go to a student majoring in engineering, science or business who best exemplifies excellence in the humanities and in the full integration of humanities into his/her undergraduate experience. Double-majors who fulfill one major in Humanities and Arts are not eligible.

CHARLES O. THOMPSON Scholars

Named in honor of the first president of WPI, this honor recognizes outstanding performance by first-year students.

To be eligible for membership, students must receive all
A's and B's, with a minimum of six A's, in their academic subjects during the first three terms at WPI. Selections are made in Term D.

A cash award is presented to the outstanding first year student. Charles O. Thompson Scholars are eligible to apply for this award by submitting an essay to the Office of Undergraduate Studies during D Term.

Special Awards

Alpha Phi Omega Service Award

AMERICAN INSTITUTE OF CHEMISTS FOUNDATION

Chemistry and Biochemistry

An award by the New England chapter of the American Institute of Chemists to honor outstanding seniors majoring in chemistry and biochemistry.

AMERICAN SOCIETY FOR METALS: CHESTER M. INMAN '14 OUTSTANDING STUDENT AWARD

Mechanical Engineering

The Worcester Chapter of the American Society for Metals presents $200 to a student for excellence in a Major Qualifying Project dealing with processing or materials science.

Harold S. Black Award

Electrical and Computer Engineering

This award was established in 2001 to honor the memory of inventor Harold S. Black '21. The award is given by the faculty of the Electrical and Computer Engineering (ECE) Department to one or more ECE seniors who have demonstrated outstanding creativity and enthusiasm in engineering problem solving, practical implementation of problem solutions, and exemplary character in their contributions to the welfare of the WPI community.

Central New England Aiche Award for Significant Contribution

Chemical Engineering

This award is given to an individual in recognition of significant contributions to the American Institute of Chemical Engineers.

Community Service Award Presented in the Memory of Edwin B. Coghlin '23

Alumni Office

This award recognizes individuals who have demonstrated an extraordinary personal commitment above and beyond their normal involvement on campus in both academic and extracurricular activities.

Computer Science Outstanding Junior Award

Computer Science

This award is presented to a computer science junior who has an excellent academic record and who shows promise for continuing success.

Computer Science Outstanding Senior Award

Computer Science

This award is presented to one or more computer science seniors who have an outstanding record and who have contributed to the enrichment and professional development of fellow students.

JAMES F. DANIELLI AWARD

Biology and Biotechnology

This award, given by the Department of Biology & Biotechnology, honors the memory of Dr. James F. Danielli, a former department head and world-famous scholar.

FRANK D. DEFALCO AWARD

Civil and Environmental Engineering

Award to WPI undergraduate Civil Engineering students who has completed two and one half years towards a B.S., interested in career constructed facilities and a member of ASCE student chapter.

Eta Kappa Nu Outstanding Student Award

Electrical and Computer Engineering

The electrical and computer engineering honor society presents this award to the outstanding senior and junior in recognition of their academic achievement and their service to the WPI community.

GENERAL CHEMISTRY ACHIEVEMENT AWARD

Chemistry and Biochemistry

This award is given to the student who has completed the freshman chemistry course with superior academic performance. Department award.

ALLAN GLAZER AWARD

Mechanical Engineering

Established in 1992 by the family and friends of Allan Glazer '47, this award is given to a junior majoring in mechanical engineering who has demonstrated outstanding academic achievement, special ingenuity in problem solving, and enthusiasm for engineering challenges.

Goat's Head Award

Student Government Association

Awarded annually to the outstanding new Senator of the year.

THE ROBERT H. GODDARD AWARD

Physics

Established by the classes of 1908 and 1909 as a memorial to Dr. Goddard, this prize is awarded for outstanding achievement, scholarship, consistent effort and dedication of purpose in both theoretical and experimental areas of physics.

HEALD BROTHERS SCHOLARSHIP

Mechanical Engineering

This scholarship identifies and supports outstanding young men and women who represent, in modern form, the spirit of "Yankee Ingenuity" that characterizes the evolution of the great manufacturing enterprises from the beginnings of the American Industrial Revolution.

ANDREW HOLT MEMORIAL AWARD

Civil and Environmental Engineering

This award is presented to a civil engineering senior who has consistently earned academic honors and who shows excellent promise for success.

Steven J. Kahn Award

Humanities and Arts

This award is presented to the outstanding senior in the WPI Glee Club in recognition of his contribution, commitment, and unwavering loyalty to the organization.

THE WILLARD ELLIOT LAWTON-SAMUEL JAMES PLIMPTON AWARD

Physics

Established in honor of Professors Lawton and Plimpton, this award is presented to a student who has shown improvement in scholarship, not only in grades but also in depth of understanding.

Lincoln Arc Welding Foundation Award

Civil and Environmental Engineering

This award recognizes outstanding achievement in solving design, engineering, fabrication, and research problems.

Medwin Honors String Quartet Scholarship

Humanities and Arts

Scholarship money is given to the members of the Medwin Honors string Quartet (4 string players, 2 violins, 1 viola, 1 cellist), who are selected by audition each year.

THE ALFRED R. AND JANET H. POTVIN AWARD

Biomedical Engineering

Separate awards are given to the outstanding undergraduate and graduate student in Biomedical Engineering in recognition of their academic performance and their service to WPI and/or the outside community.

CARL F. MEYER IMPROVEMENT AWARD IN CIVIL ENGINEERING

Civil and Environmental Engineering

Established by Professor Emeritus Meyer, this award is presented to the civil engineering senior who has demonstrated the most improvement in academic and professional attitude since entering the department.

RICHARD V. OLSON AWARD

Mathematical Sciences

Established to honor the memory of mathematics Professor Richard V. Olson, this annual award to a WPI sophomore recognizes outstanding performance in basic mathematics courses.

EDWARD C. PERRY AWARD

Mechanical Engineering

This award is given annually to an engineering student or students for an outstanding major qualifying project in the area of mechanical design. The award is made possible through a bequest from Miriam Perry Goll and honors the memory of her father, Edward C. Perry '04, a design engineer with General Electric Company throughout his professional career.

PI TAU SIGMA AWARD FOR EXCELLENCE

Mechanical Engineering

The mechanical engineering honor society, Pi Tau Sigma, presents this award to the outstanding junior mechanical engineering student.

Robotics Engineering Outstanding Junior Award

Robotics Engineering

This award is presented to a robotics engineering junior who has an excellent academic record and who shows promise for continuing success.

Robotics Engineering Outstanding Senior Award

Robotics Engineering

This award is presented to one or more robotics engineering seniors who have an outstanding record and who have contributed to the enrichment and professional development of fellow students.

Senior Mathematical Sciences Major Award

Mathematical Sciences

This award is presented to the senior mathematical sciences major who has shown outstanding performance and who has made valuable contributions to the WPI mathematical community.

SOCIETY OF MANUFACTURING ENGINEERING SCHOLARS AWARD

Mechanical Engineering

An SME Student Chapter member, recommended by the faculty and confirmed by the officers of SME chapter 25, who has demonstrated excellent scholarship, leadership, service, potential to contribute to the profession of Manufacturing Engineering.

The award includes scholarship assistance ($900) for full-time study if the winner enrolls in WPI's graduate MFE program.

SOCIETY OF MANUFACTURING ENGINEERING UNDERGRADUATE SCHOLARSHIP AWARD

Mechanical Engineering

Awarded to a 1st, 2nd, or 3rd year SME Student Chapter member, recommended by the faculty and confirmed by the officers of SME chapter 25, who has demonstrated excellent scholarship and commitment.

Society of Manufacturing Engineers Outstanding Student Award

Mechanical Engineering

Awarded to the top three SME Student Chapter members each year, regardless of year, who have not already received the award.

Society of Manufacturing Engineers MQP Award

Mechanical Engineering

An SME Student Chapter member, selected by a panel of practicing manufacturing engineers to have the best MQP in the area of Manufacturing Engineering.

STUDENT-ALUMNI INTERACTION AWARD

Alumni Office

This award is presented by the WPI Alumni Association in recognition of individuals who, through their involvement on campus, have facilitated the continuing development of interaction between students and alumni. Recipients are full-time undergraduate students who have demonstrated extraordinary personal commitment to WPI and the Alumni Association above and beyond the normal involvement on campus.

The award is designed to recognize students who have stepped forward to become leaders in the alumni and student communities and, in doing so, have benefited both WPI students and alumni in a unique and purposeful way.

ACS UNDERGRADUATE AWARD IN ANALYTICAL CHEMISTRY

Chemistry and Biochemistry

Award which is intended to encourage student interest in analytical chemistry and to recognize a student who displays an aptitude for a career in the field. This award is for third-year students.

Degree Requirements

WPI Degree Requirements

WPI Degree Requirements

(effective for students matriculating after August 1, 2011)

WPI's academic requirements are specifically designed to develop an overall educational experience which meets the goals of the college. Each requirement plays a supporting role as follows:

- To provide intellectual breadth and a better understanding of themselves and the diversity and creativity of human experience, every WPI student must complete a Humanities and Arts Requirement;
- To provide an understanding of the priorities of other sectors of society, develop the ability to communicate effectively with disparate groups, organize and derive solutions to complex problems, and gain an awareness of the interrelationships between technology and people, every WPI student must complete an Interactive Qualifying Project (IQP);
- To provide a capstone experience in the professional discipline, to develop creativity, instill self-confidence and enhance the ability to communicate ideas and synthesize fundamental concepts, every student must complete a Major Qualifying Project (MQP);
- To provide for learning through an academic program with fabric and course balance while encouraging individual student choices within that framework, every student must fulfill Distribution Requirements.

WPI Terms and Credit Units

The Bachelor degree from WPI normally is based upon a residency at WPI of 16 terms. WPI operates on a system with four seven-week terms, two in the autumn semester (Terms A and B) and two in the spring semester (Terms C and D). A summer session, Term E, is also available. The normal academic load for each term is defined as one unit of work, usually divided among three courses or projects. Thus, the usual credit unit for courses or independent study/projects is 1/3 unit. Qualifying Projects require one full unit of activity which may be concentrated into a single term (especially if conducted off-campus) or spread throughout an academic year. The degree will be awarded upon completion of the following:

DEGREE REQUIREMENTS:

1. **The Humanities and Arts Requirement** Qualification by overall evaluation of two units of work in the humanities and arts.
    - To provide intellectual breadth and a better understanding of themselves and the diversity and creativity of human experience, every WPI student must complete a Humanities and Arts Requirement.
2. **The Mathematics and Science Requirement** (See distribution requirements for individual programs)
    - The Mathematics and Science Requirement defines a minimum standard of scientific, technological, engineering, and mathematical literacy for graduates of WPI, regardless of major field. Most degree programs will provide a substantial level of preparation in most of these areas, far beyond this standard. Students will satisfy this requirement by satisfying the program requirements of their individual major programs.
    - The goals of the Mathematics and Science Requirement at WPI are that students will be able, in their careers and daily lives, to: 1) explain and apply key concepts and principles of scientific disciplines and use an understanding of scientific methods to make critical judgments, 2) apply mathematical methods to understand the solution of real-world problems, 3) productively and appropriately use computers and other technology, 4) use methods from the quantitative, natural or engineering sciences to systematically identify, formulate, and solve problems.
    - The specific requirement is two units of work in science, engineering, mathematical science or computer science. Two-thirds units of work must be in Quantitative Science; two-thirds units of work must be in Natural or Engineering Science; the final two-thirds unit may be from any of the Quantitative, Natural, or Engineering Sciences. Each major program may decide which courses and/or prefixes count for each category. Each major program may set more restrictive requirements as the program sees fit.
3. **The Interactive Qualifying Project**
    - Successful completion of a qualifying project relating science and/or technology to society (the Interactive Qualifying Project, or IQP) representing at least one unit of credit in project or independent study work. The format of the documentation is to be in accordance with current WPI policy on such documentation.
4. **The Major Qualifying Project**
    - Successful completion of a qualifying project in the major area of study (the Major Qualifying Project, or MQP) representing at least one unit of credit in project or independent study work. The format of the documentation is to be in accordance with current WPI policy on such documentation.
5. **Distribution Requirements** (See program description for specified departments)
    - Satisfaction of published academic activity distribution requirements in or relating to the major area of study. These requirements typically total no more than ten units (including the MQP and two units to fulfill the Mathematics and Science Requirement) and are specified by general topical subject area, not by specific courses. Completion of distribution requirements will be certified by the appropriate Program Review Committee (PRC), upon recommendation by the student's academic advisor. For students desiring designation of a major area for which a determination regarding distribution requirements has not previously been made and published, a faculty committee will be appointed by the department head or DIGS dean to review and approve the student's program of study.
6. **Social Sciences**
    - Completion of 2/3 unit of work in the social sciences, exclusive of qualifying project.
7. **Residency Requirement**
    - A minimum of eight units *must* be completed satisfactorily in residence at WPI. (It is anticipated the normal residence at WPI will be 16 terms.)
8. **Minimum Academic Credit**

    - The minimum academic credit required for the Bachelor degree is 15 units. Credit accumulated beyond the published distribution requirements shall be accomplished by the addition of "free elective" work.
9. **Wellness and Physical Education**
    - Qualification in wellness and physical education shall be established by completing 1/3 unit of course work (four WPE classes) or its equivalent. Such an equivalent, for example, may be participation in club or varsity sports.

Degree Options

Concentrations

Definition

A Concentration is an option associated with a major which provides recognition for focused and coordinated academic work either within the major or within an area of study closely related to the major.

Rules

1. All Concentrations require completion of two units of integrated academic study plus an MQP with a topic and content appropriate to the given Concentration.
2. Concentrations deemed to belong exclusively or primarily within the stated major must be accommodated within the distribution requirements of that major.
3. Concentrations deemed to have a substantial interdisciplinary nature can exceed the normal 10-unit allotment of the major by as much as 1 unit, provided that the additional requirements do not include or permit academic work designated by the major prefix or coursework normally taken to satisfy the major's portion of the distribution requirements. Furthermore, Concentrations of an interdisciplinary nature are permitted to use up to 1 unit of the academic program beyond the distribution requirements of the major, including the IQP, Social Science requirement, and Free Electives, as deemed appropriate.
4. The requirements of the Concentration must be designed to offer choices for the student within the major area and, if relevant, outside the distribution requirements of the major; however, the Concentration requirements must not preclude meeting the normal distribution requirements for the major.
5. Rules and guidelines for each Concentration will be formulated by the faculty associated with the governing major, and must be reviewed by the Committee on Academic Operations (CAO) and subsequently approved by the Faculty. CAO is empowered to rule on whether a proposed Concentration is disciplinary or interdisciplinary.
6. An individual program of study leading to a major with a Concentration will be planned by a student in consultation with his/her academic advisor. The student's intention to pursue a Concentration will be declared by application to the appropriate Program Review Committee in accordance with that Committee's schedule of deadlines. Application deadlines should be designed to enable Committee review and communication of decisions to students at a sufficiently early point that flexibility of schedule still exists. Extenuating circumstances may be considered at the discretion of the Program Review Committee.
7. Concentrations and minors are additional degree designations. Any credit earned for an additional degree designation **must not overlap with credit earned for another additional degree designation by more than one unit. Also, no credit-bearing activity may be triple-counted** towards degree designations or degree requirements.

Minors

Definition

A minor is a thematically-related set of academic activities leading to a degree designation in addition to but separate from that granted by the major. A minor should be available to students of any major, with the exception of a minor which overlaps with a major area to such an extent that it is not sufficiently distinct from that major. The Committee on Academic Operations (CAO) is responsible for the review of proposed minor programs and decisions regarding allowed major/minor combinations.

Rules

1. A minor requires completion of two or more units of thematically related activity. Individual departments may impose additional restrictions such as a capstone or integrative experience. Students should consult individual minor Program descriptions in Section 2 of this catalog for these restrictions.
2. It is expected that minor requirements will be structured so that all acceptable major/minor combinations can be accommodated within a normal 16 term framework.
3. A minor may include any portion of the academic program, excluding the MQP. Academic activities used in satisfying the regular degree requirements may be double-counted toward meeting **all but one unit of the minor requirements**, subject to the following restrictions:
    1. The one unit of double-counted work may include at most 1/3 unit of the IQP, 3/3 units of the Humanities and Arts Requirement, or a combination thereof.
    2. At least one unit of the minor must be free elective choices.
4. The Program Review Committee for a minor area will consist of faculty members designated by the sponsoring faculty members.
5. A minor area must be proposed by a sponsoring group of faculty and must be defined by the purpose of achieving an educational goal beyond those apparent or implicit in the regular degree requirements. Student- initiated minor programs must be developed with the approval of a sponsoring group of faculty advisors. Each minor program must be reviewed by CAO for its individual merit.
6. Minors are additional degree designations. Any credit earned for an additional degree designation **must not overlap with credit earned for another additional degree designation by more than one unit. Also, no credit-bearing activity may be triple-counted** towards degree designations or degree requirements.

Minors are described in the "Program Description" section of this catalog. Minors sponsored by a department are described following the department. Others are listed in the "Interdisciplinary Minors" section. Follow this link to the current list of approved minors:

WPI Minors Listing

Interdisciplinary or Individually Designed (ID) minors are approved by the Committee on Academic Operations (CAO).

The form needed to declare a minor or to propose an interdisciplinary or individually designed minor can be found under Curriculum Adjustments on the Registrar's Office website.

Double Majors

An option for some students who wish to broaden their WPI experience is the completion of two distinct majors through the double major option. The choice to pursue a double major should be made early in a student's career. No student shall complete more than two undergraduate majors.

A double major should signify capacity in two distinct disciplines. Some combinations of double majors are not sufficiently distinct to merit this designation. Departments and programs decide whether any combinations of double majors overlap to such an extent as to be disallowed. As of the publication date of this catalog, the following combinations are not allowed:

- Actuarial Mathematics and Mathematical Sciences
- Aerospace Engineering and Mechanical Engineering
- Biochemistry and Chemistry
- Business and Management Engineering
- Business and Management Information Systems
- Civil Engineering and Architectural Engineering
- Civil Engineering and Environmental Engineering
- Industrial Engineering and Management Engineering with Concentration in Industrial Engineering
- Interactive Media and Game Development Technology and Interactive Media and Game Development
- Management Information Systems and Management Engineering with Concentration in Information Technology
- Physics and Applied Physics

Students who wish to pursue any double major should consult with faculty advisors in both majors. Exceptions to disallowed double majors must be approved by the Committee on Academic Operations.

Degree requirements for double majors are as follows

1. **Distribution Requirements.** The distribution requirements of each major must be met, but requirements common to both majors have to be met only once.
2. **The Humanities and Arts Requirement.** No modifications are made to the Humanities and Arts Requirement for double majors. All students, including majors in Humanities and Arts or International and Global Studies must satisfactorily complete the Humanities and Arts Requirement culminating in an Inquiry Seminar or Practicum
3. **The Interactive Qualifying Project.** If one of the majors of a double major is in Social Science and Policy Studies, a single project bearing at least one unit credit may be used to satisfy both the MQP requirement for the SSPS major and the IQP requirement. In order to be used to satisfy both requirements, the combined social science MQP and IQP must meet the goals of both projects. It must be interactive in nature involving an aspect of technology, and must also be an application of social science knowledge and analytical techniques. In order to select a single project that satisfies both the goals of the MQP and the goals of the IQP, the decision to pursue a social science double major needs to be made fairly early in the student's career.
4. **The Major Qualifying Project.** The MQP requirements for Double Majors may be fulfilled in either one of two ways:
   1. Option 1: Two distinct projects, one in each major, each of at least one unit of credit.
   2. Option 2: One interdisciplinary project of at least 4/3 units of credit, and having significant work associated with each major. An interdisciplinary project must be:
   - jointly advised by at least two faculty members, one associated with each of the relevant degree programs; OR
   - advised by a single faculty member who is associated with both of the relevant degree programs.

Faculty associated with each degree program are listed on the departmental page. Please follow this link for a directory of WPI Faculty.

An interdisciplinary MQP involving social science may not be used as an IQP.

The interdisciplinary MQP option takes advantage of the value of interdisciplinary work at the intersection of the two majors. Students undertaking an interdisciplinary MQP must complete an *interdisciplinary MQP approval form* in advance of project registration, and this form must be signed by all advisor(s) on the project. This form must contain a summary of the proposed project work indicating the content relating to each major. The interdisciplinary MQP option is available only at the discretion of the faculty and only when all faculty advisor(s) agree on the project content. Students planning to use this option should identify and consult with their faculty advisor(s) well before the end of their junior year.

For a double major, completion of a 4/3 unit interdisciplinary MQP completes the 1 unit MQP requirement for each major. The assignment of credit is as follows: 2/3 unit is double counted toward each major, and the remaining 2/3 unit is allocated as 1/3 unit to one major and 1/3 unit to the other major.

Note: It is anticipated that in some cases a student pursuing a double major will join a project team whose other members are pursuing a single major. The double-majoring student will bring the interdisciplinary content to the project, and this additional work will be represented by the additional credit that that student (perhaps only that student) earns, and with an enlarged report prepared by that student.

For students wishing to pursue double majors, the program audit for each intended major must be completed and certified by the review committee of each department involved. Academic activities appropriate to both majors may be counted in both majors. For the policy in the special situation of double majors involving the social sciences see the Social Science and Policy Studies department description in Section 2 and the Double Major Distribution Requirements in Section 4 of the Undergraduate Catalog.

Certain interdisciplinary MQP's and corresponding double-majors in the same department are not allowed.

Interdisciplinary MQP's with two faculty advisors: All faculty advisors have equal status in approving the final project, and a single grade is submitted for each term's work and a single project grade is submitted on the CDR form. Should an interdisciplinary MQP, once completed, be deemed acceptable as an MQP for one of the two majors, but not for the other, and/or if the faculty advisors cannot agree on a single grade after much effort to do so, the project may be considered as the MQP for a single major. This conversion can only occur with the consent of the student and the advisor(s) from the single major being selected.

Projects and Research

At the heart of the WPI Plan is student research, open-ended inquiry, and original and creative design to solve problems and to make new discoveries. All students in all majors complete two qualifying projects:

1. The Major Qualifying Project (MQP),
2. The Interactive Qualifying Project (IQP).

The *Major Qualifying Project* requires the synthesis of all previous study as well as the development of new knowledge to solve problems in the student's major field. The MQP challenges the student to perform at an advanced level, as a professional would, and to communicate the results effectively.

The *Interactive Qualifying Project* challenges students to address a problem at the intersection of science and technology with human need.

These projects are substantial and are each equivalent to at least one-fourth of an academic year's worth of effort. Most IQPs are completed at an off-campus project center in collaboration with an external sponsor.

Projects must be accepted by a project advisor before project registration can be completed. Many project opportunities come from off-campus organizations, address real-world problems and thus provide experience invaluable for seeking jobs and for professional practice. Students are also encouraged to develop their own project ideas, to identify and work with interested faculty, and to form teams to pool resources and share points of view.

Resources - Getting Started

There are many opportunities for students to learn about project opportunities both in the major (for the MQP) and for the IQP. Advice and links to additional resources can be found on the Undergraduate Studies web page.
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Available Projects

Students may obtain information about new or ongoing projects from a variety of sources. Principal sources include discussions with other students, especially those currently involved in a project, the Projects Program web site, department offices, or their web pages. Off-campus projects are discussed annually in the fall. In the spring, Project Opportunities in eProjects can be used as a directory of specific IQP projects or as a source of ideas for developing your own projects. Some students will find a project listed which fits their needs and interests exactly. In other cases, the listing will serve to lead students to a faculty member with whom project involvement can be negotiated. The proposals in eProjects are updated periodically to provide an accurate listing of available projects.

Students are encouraged to check the web site of the department of their major and Project Opportunities for MQPs in eProjects (https://eprojects.wpi.edu/), as well as consulting with their academic advisors and with faculty in their courses. In addition, academic departments hold special events where faculty present project and other research opportunities to connect with students who are currently doing research.

Project Advisor

Academic advisors can assist students in identifying a project. They are aware of the project interests of many other faculty members, and have a list of faculty interests which will enable a student to find a faculty member who can help to develop a project idea. Faculty associated with the Department of Integrative & Global Studies (DIGS) are available to assist students in interdisciplinary and interactive projects.

Project Performance and Time-on-Task

A student is normally expected to expend 15-17 hours per week on the average for each 1/3 unit of credit for project work, and expected achievement is based upon that commitment.

A project group, whether it involves one student or more, should have a minimum of one scheduled conference per week with the advisor(s). Additional time should be scheduled when the effort exceeds 1/3 unit per student or when more students are involved.

Students should be prepared to submit interim project reports to the advisor each week. Students are also encouraged to complete a proposal at the beginning of the project activity to define the scope and timeline for completion of the effort. In addition, oral reports may be required as determined by the advisor. At the end of the project, a report must be prepared to the satisfaction of the project advisor. For projects sponsored by off-campus organizations, both a written and oral report for the sponsors is normally expected.

Qualifying Project Grading

The Faculty of WPI has endorsed the following grading guidelines for qualifying project activity:

1. Each term a student is registered for a qualifying project, the student receives a term grade reflecting assessment of his or her accomplishments for that term.
2. Upon completion of a project, each student will receive an overall project grade (also known as the "CDR grade," since it certifies completion of the degree requirement) reflecting his or her individual overall accomplishments for the project.
3. The term grades and the overall project grade reflect both the *products* of the project (e.g., results, reports, etc.) and also the *process* by which they were attained. The term grades and the overall project grade may be different.

The following are some characteristics that faculty should use in communicating expectations and evaluating the quality of each student's project work.

The degree to which the student:

- developed effective or creative goals or approaches,
- demonstrated initiative and originality,
- showed depth and critical thought in analysis,
- produced high quality results,
- took the lead in discussion, planning, and analysis,
- produced a clear, professional-level report with excellent drafts along the way,
- anticipated work that needed to be done and completed it in a timely manner, and
- worked to advance the success of the team.

For both terms and overall project, the available grades and interpretations are:

A: This grade denotes *excellent work* that attains all of the project goals and learning outcomes. The product and process of this work meet all of the expectations and exceed them in several areas.

B: This grade denotes *consistently good work* that attains the project goals and learning outcomes. The product and process of this work meet but generally do not exceed all of the expectations.

C: This grade denotes *acceptable work* that partially attains project goals and learning outcomes. The product and process of this work meet some but not all expectations.

SP: This grade denotes *satisfactory progress* and certifies sufficient accomplishments to earn credit for that term. Faculty who assign this grade should provide clear feedback to the student regarding his or her progress during the term. The use of the SP grade is discouraged except in circumstances where the faculty member is unable to judge the quality of the work, yet can attest that the granting of credit is appropriate. This is a temporary grade and must be replaced by a permanent grade consistent with the criteria outlined above by, if not before, the end of the project.

NR: This grade denotes work that did not attain the project goals or learning outcomes and is *insufficient for registered credit*. Both product and process were inconsistent with acceptable project work at WPI as outlined above.

NAC: This grade is reserved for *performance that is unacceptable*. It might mean that a student's performance (or lack of it) has seriously impeded group progress, or it has embarrassed the group, a project sponsor, or WPI. Note that this grade remains on the transcript.

4. Project goals should be established and clearly articulated early in the project. This may be done in the form of a formal project proposal. Learning outcomes for the qualifying projects have been established by the faculty and are published in the undergraduate catalog.

5. Project advisors should clearly convey in writing their expectations for learning and performance to project students at the start of the project, and provide students with substantive feedback on a regular basis during the project.

Electronic Project Submission

WPI requires that all undergraduate students submit their Interactive Qualifying Project (IQP) and Major Qualifying Project (MQP) electronically (https://eprojects.wpi.edu/).

Students must be registered for a minimum of 1/6 unit of qualifying project credit in the term in which the final project report is submitted.

No matter which format is used to create the original report document (Microsoft Word, LaTeX or other), the final report must be converted to a PDF format in order to be submitted as an eProject. The final PDF is required, and additional related files such as simulations, computer programs, multimedia, and data sets may be submitted as a component of the project. Guidance on eProject report formatting and file formats for the final report and any supplementary files is provided within the online submission process, and detailed instructions are available from an online guide at the Gordon Library: https://libguides.wpi.edu/submitprojects.

The final project report should be carefully proofread. Once the submitted project has been approved by the advisor and released to WPI's digital repository (Digital WPI) by the Registrar's Office, it is considered an academic record and cannot be edited.

The deadline for the submission of the initial report draft and the final document may be established at the discretion of the project advisor. Drafts and reports need ***not*** be accepted by the advisor after the established deadline.

A project that is completed by a team of students, except in extenuating circumstances, will submit ONE project report from the group. After the MQP or IQP team submits the final version of the project report, the advisor must review the work and approve or reject it online at https://eprojects.wpi.edu/.

Group Qualifying Project Efforts

Students meeting a qualifying project degree requirement by participation in a group, or team effort, will submit, at the discretion of the project advisor, either a single, comprehensive written report from the group, or individual written reports from each member of the group. A single, comprehensive written report must, however, include some means by which each individual's contribution to the group effort may be clearly identified. This identification may take the form of an "authorship page," simply a list of individual chapters and their respective authors, or of a prefacing statement in which each contributing group member is named as having carried out one or more specific tasks within the overall project effort.

In the case where one or more students leave an ongoing group project after having contributed at least one unit each of project effort, those students, again at the discretion of the project advisor, will submit either a single written report or individual written reports in satisfying the qualifying project documentation requirement. The same means of identifying individual contributions will be employed as described above.

Dissemination of Project Reports

Completed project reports are made available to the public through Digital WPI, managed by WPI's Gordon Library (https://digital.wpi.edu).

MQPs and IQPs completed for off-campus agencies are usually distributed within the sponsoring agency by the agency project liaison. A project report may be redacted or restricted from public viewing for a defined period of time, if it contains confidential or proprietary information of a sponsoring agency.

Students are responsible for keeping personal copies of project reports for their own permanent professional records. In this way, reports can be reviewed for later use, and incorporated into a professional portfolio.

Thus, MQPs and IQPs are best viewed as research reports which establish good professional practices as well as being potential sources for further study and research.

Pay & Credit (for students working on sponsored projects)

Linked here

Projects

Project Planning

During the academic planning period, which starts in February, students who intend to conduct project work during the following year should set aside time to plan their projects, meet with faculty, and form project teams. Any pre-planned projects will be posted on the project opportunities section in e-projects (https://eprojects.wpi.edu/). Students are also encouraged to meet with faculty individually.

The most important and difficult part of a project is the planning which precedes the execution. The planning phase of your project will involve developing a background, talking to people in the field, finding out what has already been done in the area, and determining what your goals are and what you need to do to accomplish them. If any special equipment, financing, or resources will be needed for execution of the project, it is especially important to make this known early to ensure that it will be available to you. In addition, most faculty members require a project proposal before registration of the project.

Project Registration

Students who intend to do project work must complete a project registration form by no later than the beginning of the first term of that project work. Students will complete their registration request through e-projects after the project is built by the project advisor and the student is added as a member. Instructions for this process can be found on the Registrar's website. Any student who will travel to an off-campus location, such as a Residential Projects Program site, is also required to fill out an electronic project registration form.

Project registration for terms A-E will be accepted up to the 10th day of the term (not including weekends) without penalty. A project involving an off-campus sponsor (MQP mostly, but some IQP) carries the further obligation of compliance with the rules and regulations of the sponsor. Often, these are specified in a formal contract between the sponsor and WPI, and are legally binding. At the time of registration, any affected student will be required to indicate the sponsor on the electronic registration form.

For an MQP, the project advisor or an associate advisor must be a member of the faculty in the discipline which corresponds to the major area of study of the student.

Change of Registration Information

Students must make all project registration changes through e-projects. Students may make changes to the project by making an addendum to the previously registered project and submitting the changes electronically to the project advisor for approval. Credit distribution can be changed for the current term through day 10, or any future terms. No changes in credit distribution can be made after day 10 of the term.

Changing Project Advisor

To change the project advisor for a degree-required project, students should contact the Registrar's Office.

Project Conferences

Students should report to their project advisor's office at the beginning of the term to make arrangements for subsequent meetings.

Overload with Project

Students are strongly encouraged to consult with their project advisor(s) before registering for an overload. Students are not permitted to overload during a one-term off-campus project offered in the Global Projects Program or during the prior term when students are enrolled in ID 2050, Social Science Research for the IQP and an associated pre-qualifying project.

Project Completion

During the final term of registration for the project and sufficiently prior to the deadline for submittal of Completion of Degree Requirement Forms, students must submit their completed project report to the project advisors. Students are also required to submit a copy of the document to the participating off-campus organization sufficiently prior to the end of the term so that proprietary and confidential information in the report can be identified and removed. Most off-campus organizations require 30 days for this review, and the grade and final report cannot be submitted to the Registrar by the project advisor until this review has been done.

Directions for submitting the project report electronically are available from the Gordon Library. A final project report is submitted electronically through the e-projects website (See Electronic Project Submission) The electronic eCDR must be submitted by the project advisor no later than the 10th day of the next academic term.

A student who has filed an application to receive their degree in May must submit a completed eCDR to the Office of the Registrar by the last Thursday in D-term.

Registration Policy for Degree Requirements

The completion of a degree requirement (MQP, IQP or Humanities and Arts Requirement) will not be recorded in the Registrar's Office after the tenth day of classes of a term unless the student is registered for a minimum of 1/6 unit *of the same activity* in that term. The deadline for receipt of the Completion Form is no later than the tenth day of classes for the next term. Any exceptions to this policy must be handled by written petition from the project advisor.

Note: Candidates for degrees must meet graduation deadlines if they differ from the above. Deadlines for degree candidates will be strictly enforced!

Only Completion of Degree Requirement (CDR) forms which are complete, correct and consistent with the student's registration records will be accepted by the Registrar's Office. (See PROJECTS AND RESEARCH section, page 14.)

Off-Campus Insurance and Legal Agreements
WPI's insurance program includes a broad range of coverage for students doing projects in cooperation with off-campus organizations. This insurance coverage requires proper documentation of individual student participation. All students doing project work with off-campus organizations must complete the pertinent portion of the project registration form. In certain cases, where the project is included as part of a regular course, the course instructor must submit to the Projects Office a list of the students going off campus and the name(s) and address(es) of the organization(s) involved.

WPI has entered into a variety of agreements with off-campus organizations, covering a wide range of issues common to the projects program. Students agree to abide by these agreements during the registration for the project.

Pay and Credit (for students working on sponsored projects)
Many WPI projects, including both the IQP and the MQP, are completed with an external partner or sponsor. It is important to emphasize that WPI project work is different from traditional internships or co-op experiences in two important ways. First, the primary purpose of the project work is always student learning, as defined by the learning outcomes associated with each project. Second, there must be a WPI faculty member advising the project who has primary responsibility for guiding the student work, for setting the goals of the work, and ensuring that the focus of the project remains student learning.

There do arise situations in projects sponsored by an external organization, usually a company or government agency, when the sponsoring organization requires that the students are classified as employees or interns and receive pay in order to work on the project. In these situations, approval from the Office of Undergraduate Studies is required.

WPI students may receive pay for work on an externally sponsored IQP or MQP when all of the following three conditions are met:

1. There is documentation, shared with the students, sponsors, and the faculty advisor(s), stating that the primary purpose of the project work is student learning.

2. WPI faculty advisor(s) have a central role in the project and have the responsibility and authority to guide and evaluate student work done on the project. The sponsor does not assign grades or evaluate student learning.

3. The Sponsored Project Agreement and the Scope of Work document is reviewed and approved/denied by the Office of Undergraduate Studies before project work begins. Proposals for pay and credit projects must be submitted for approval/denial by the Office of Undergraduate Studies before the fifth day of the academic year term (A, B, C, or D) or summer term (E1 or E2) preceding the term when project work will begin.

Note that, in order to receive academic credit, students must be registered for the project during the terms in which project work is being done. Work performed with an external sponsor prior to registration – and outside the three conditions described above – will not receive academic credit.

Global Projects Program
The Global Projects Program offers WPI students the opportunity to complete a project at one of WPI's off-campus project sites. Some centers are residential, with students traveling to and living on site for an entire term, while others offer the opportunity to complete an off-campus project in Worcester, Boston, or other nearby communities. Project work conducted at these sites provides teams of students with extraordinary opportunities to learn by addressing real-world problems provided by industry, non-profit, non-governmental or government agencies.

The application process for these programs begins in the fall with the Global Fair. At the Fair, IQP, MQP, HUA and exchange program directors will be available to talk with students. Typically, students apply in Term A of the year preceding the year in which they would like to participate. Further information is available at the Global Experience Office in the Project Center or at https://www.wpi.edu/student-experience/resources/off-campus-projects.

The Global Experience Office strives to create project opportunities for all WPI students, but many project sites are in high demand and students are not guaranteed a placement at their most desired site. Accepted students must complete a series of pre-departure orientations and submit required paperwork to be eligible to travel.

All students accepted to an off-campus IQP Center will be registered for the preparation courses (ID 2050 and PQP) in the term immediately preceding their planned term of travel. Some preparation begins as early as two terms prior to departure. Students must be making satisfactory progress in their academic coursework in order to participate. Students must also follow all policies and procedures for off-campus projects which are overseen by the Global Experience Office: https://www.wpi.edu/student-experience/resources/off-campus-projects/policies.

Prior to leaving campus for a project program site, each student is required to complete a project registration form.

The Interactive Qualifying Project

At WPI, students are expected to develop an understanding of how science and technology are embedded in the fabric of society. The Interactive Qualifying Project (IQP) challenges students to address a problem that lies at the intersection of science or technology with society. During the IQP, students work in interdisciplinary teams, often with an external sponsoring organization, to address real world problems. In doing so, students learn something about the role of science and technology, its impact on society, its place in meeting human needs and human efforts to regulate, control, promote and manage our changing technologies. The IQP is equivalent to three courses, typically undertaken in a student's junior year. It can be completed over three terms, or as a full course load for a student for one term, and it can be completed on-campus, or at one of our many residential project centers in the U.S. and abroad. For more on the IQP, visit https://www.wpi.edu/academics/undergraduate/interactive-qualifying-project. For more on the IQP and study abroad, see the Global Projects Program website. Completed IQP reports are electronically archived and made available to the public through Digital WPI, managed by WPI's Gordon Library (https://digital.wpi.edu).

IQP Learning Outcomes

The Faculty adopted the following statement defining learning outcomes for the IQP. Successful completion of an IQP is an important element in helping students achieve WPI's overall undergraduate learning outcomes.

Students who complete an Interactive Qualifying Project will:

1. Demonstrate an understanding of the project's technical, social and humanistic context.
2. Define clear, achievable goals and objectives for the project.
3. Critically identify, utilize, and properly cite information sources, and integrate information from multiple sources to identify appropriate approaches to addressing the project goals.
4. Select and implement a sound methodology for solving an interdisciplinary problem.
5. Analyze and synthesize results from social, ethical, humanistic, technical or other perspectives, as appropriate.
6. Maintain effective working relationships within the project team and with the project advisor(s), recognizing and resolving problems that may arise.
7. Demonstrate the ability to write clearly, critically and persuasively.
8. Demonstrate strong oral communication skills, using appropriate, effective visual aids.
9. Demonstrate an awareness of the ethical dimensions of their project work.

Preparing for and Finding an IQP

Students are encouraged to view the IQP as a learning opportunity – a chance to gain knowledge outside their major field – while working with others to address open-ended, complex problems. The best approach is to consult with one's academic advisor and select courses to be taken in the first and second year at WPI that can provide a foundation for an IQP in the junior year. Often project preparation involves developing an understanding of the social sciences and humanities, as the concepts and analytical techniques of these disciplines are important in understanding the social context of science and technology. In addition, students enrolled in the Global Projects Program for their IQP will be expected to complete a course devoted to project preparation in advance of their travel.

Project topics originate with external organizations, faculty and students. Students who complete IQPs at an off-campus project center through the Global Projects Program work on project topics identified by external sponsoring organizations. Students can explore these opportunities in eProjects (eprojects.wpi.edu) and at the Global Opportunities Fair organized each September by the Global Experience Office (GEO, https://www.wpi.edu/offices/global-experience). Students completing projects on campus are encouraged to seek faculty members that share their interests to advise projects. Faculty interested in advising specific IQPs will post their project topics in eProjects (eprojects.wpi.edu). The Global School also hosts an On-Campus Project Opportunities Fair each March where students can meet faculty advisors to discuss projects being offered on campus during the following year.

The Global School and Global Experience Office offer administrative support for project activities. Students are welcome to seek further assistance from the staff on the first floor of the Project Center.

What are IQPs About? Science, Technology, and Society

A detailed explanation of the IQP and its options can be found at https://www.wpi.edu/academics/undergraduate/interactive-qualifying-project. Proposed projects can be located in eprojects.wpi.edu. IQP (and MQP) projects are searchable in Digital WPI (https://digital.wpi.edu/).

The Major Qualifying Project

The qualifying project in the major field of study should demonstrate application of the skills, methods, and knowledge of the discipline to the solution of a problem that would be representative of the type to be encountered in one's career. The project's content area should be carefully selected to complement the student's total educational program. In defining the project area within which a specific topic is to be selected, the student and academic advisor should pay particular attention to the interrelationships that will exist between the bodies of knowledge represented by courses, independent studies, and Preliminary Qualifying Projects; and by the Interactive Qualifying Projects.

MQP activities encompass research, development, and application, involve analysis or synthesis, are experimental or theoretical, emphasize a particular subarea of the major, or combine aspects of several subareas. In many cases, especially in engineering, MQP's involve capstone design activity. Long before final selection of a project topic, serious thought should be given as to which of these types of activities are to be included. Beyond these considerations, the MQP can also be viewed as an opportunity to publish or to gain experience in the business or public sectors.

Off-campus MQPs are also very valuable for access to state-of-the-art resources and contacts for future professional work.

Getting Started on an MQP

Project topics are originated by students, faculty, or practicing professionals participating in WPI's off-campus project programs. A faculty member in each academic department acts as Project Coordinator for all majors within the department. The Project Coordinator has assembled MQP topic descriptions being proposed and has identified the faculty who will serve as project advisors for each topic. All project opportunities-MQP, IQP, PQP, on-campus originated and off-campus originated are made available to the student body through a planned information-sharing program of activities during C and D terms of the academic year prior to the start of the project.

Project Proposals

Students are strongly encouraged to begin their MQPs with a project proposal. A detailed guide to preparing project proposals is available in department offices or on the Projects Program web page (https://www.wpi.edu/academics/Projects/).

MQP Learning Outcomes

By completing their MQP, WPI students will achieve the following learning outcomes at a level at least equivalent to that of an entry level professional or graduate student.

Students who complete a Major Qualifying Project will:

1. apply fundamental and disciplinary concepts and methods in ways appropriate to their principal areas of study.
2. demonstrate skill and knowledge of current information and technological tools and techniques specific to the professional field of study.
3. use effectively oral, written and visual communication.
4. identify, analyze, and solve problems creatively through sustained critical investigation.
5. integrate information from multiple sources.
6. demonstrate an awareness and application of appropriate personal, societal, and professional ethical standards.
7. practice the skills, diligence, and commitment to excellence needed to engage in lifelong learning.

Specific disciplinary programs may add additional MQP outcomes, such as design or mathematical skills or teamwork, as appropriate.

MQP Project Centers

Each project center has a WPI faculty member as the director, well-defined procedures for completing project work, and selective admissions processes. The Centers tend to be highly structured and require superior performance.

At the present time, the WPI project center close to campus is:

- University of Massachusetts Medical School Project Center/ Tufts University Cummings School of Veterinary Medicine.

Major qualifying projects are available at nearby University of Massachusetts Medical School (UMMS) and Tufts University Cummings School of Veterinary Medicine (TUCSVM) for students from many disciplines on campus. These institutions are nationally recognized for research and medicine and offer project opportunities over a wide range of research areas. Students performing projects at these centers work in cutting edge research programs and typically interact with graduate and post-doctoral researchers to solve real-world problems.

It is recommended that students spread their projects over the entire academic year. Students from any major interested in project opportunities should contact Dr. Destin Heilman in the department of Chemistry and Biochemistry.

Humanities and Arts Requirement

Overview

The Humanities and Arts Requirement empowers students to meet the broad educational goals of WPI. The balance between technological and humanistic education and the emphasis on inquiry-based approaches to student learning have been and remain hallmarks of a WPI education. In concert with WPI's other degree requirements, the Humanities and Arts Requirement embodies the institute's definition of an educated person. The Humanities and Arts Requirement engages students with theory and practice – *Lehr und Kunst* – through the following educational goals.

Goals of the Humanities and Arts Requirement

- To introduce students to the breadth, diversity, and creativity of human experience as expressed in the humanities and arts;
- To develop students' ability to think critically and independently about the world;
- To enhance students' ability to communicate effectively with others in a spirit of openness and cooperation;
- To enrich students' understanding of themselves;
- To deepen students' ability to apply concepts and skills in a focused thematic area through sustained critical inquiry;
- To encourage students to reflect on their responsibilities to others in local, national and global communities;
- To kindle in students a life-long interest in the humanities and arts.

Meeting the Requirement

Students fulfill the humanities and arts degree requirement by completing two units of work consisting of five student-selected courses followed by a 1/3 unit Inquiry Seminar or Practicum (HU 3900, HU 3910, or equivalent). In selecting the courses, students must complete depth and breadth components of the requirement, as described below. *All 5 HUA courses must be completed before beginning the Inquiry Seminar or Practicum.* At the end of the Inquiry Seminar or Practicum, every student will submit a completion-of-degree requirement form (CDR) to certify completion of the requirement.

Depth Component:

The WPI Plan calls for students to develop a meaningful grasp of a thematic area of the humanities and arts. *To ensure this depth, students complete at least three courses of thematically-related work prior to a culminating Inquiry Seminar or Practicum in the same thematic area.* Thematically-related work can be achieved in two ways:

1. Focusing on one of the following disciplines or disciplinary areas:
    1. art/art history (AR)
    2. music (MU)
    3. theatre (TH)
    4. literature and writing/rhetoric (EN, WR, RH)
    5. history and international and global studies (HI, HU, INTL)
    6. philosophy and religion (PY, RE)

    Paths for language study are described below.

2. Defining the thematic area across disciplines or disciplinary areas in consultation with a Humanities and Arts faculty member.

To ensure that students develop a program of increasing complexity, at least one of the three thematically-related courses that precede the Inquiry Seminar or Practicum must be at the 2000-level or above. Students are strongly encouraged but not required to include a 3000-level course within their depth component. The structure of the requirement remains flexible so that students will become intentional learners as they select a sequence of thematically-related courses.

Breadth Component

To ensure intellectual breadth, before taking the final Inquiry Seminar or Practicum, students must take at least one course outside the grouping in which they complete their depth component. To identify breadth, courses are grouped in the following manner:

- art/art history, theatre, and music (AR, TH, MU);
- languages (SP, GN, ISE, AB, CN);
- literature and writing/rhetoric (EN, WR, RH);
- history and international and global studies (HI, HU, INTL);
- philosophy and religion (PY, RE).

WPI offers a flexible curriculum to entrust students with a significant amount of choice and responsibility for planning their own course of study. At the same time, WPI requires students to take at least one course outside the depth area in order to provide exposure to more than one disciplinary approach within the arts and humanities, which include the creativity of the fine and performing arts, modes of communication in languages and literature, and the cultural analysis of the past and present. Students are encouraged to experiment and to take courses in more than one group outside the depth area if they wish. By providing exposure to multiple areas, the breadth component encourages students to appreciate the fundamental unity of knowledge and the interconnections between and among diverse disciplinary fields.

The one exception to this breadth requirement is that students may take all six courses in a foreign language.

Depth and Breadth Components in Modern Languages

Development of proficiency in a language necessitates sustained engagement in the language beyond the elementary and intermediate level. Language instruction is broadly interdisciplinary and includes elements of the history, literature, and culture of a particular language area. A student in languages must still meet the depth component of the requirement by taking 6 courses in the language, one of which is approved as the final Inquiry Practicum or Seminar. Additional information about options for the Inquiry Practicum or Seminar in Chinese (CN), English for Non-Native speakers (ISE), German (GN) and Spanish (SP) can be found later in this section. A student who begins language study is not compelled to remain in that subject, but could choose to switch to another subject of study and complete the depth component in another thematic area.

Inquiry Seminar or Practicum

The culmination of the depth component of the Humanities and Arts Requirement is an inquiry seminar or practicum. The educational goals for the seminar or practicum are the same regardless of the format.

Objectives of the Inquiry Seminar or Practicum

- *Critical inquiry*: to develop each student's ability to apply concepts and skills learned in the humanities and arts, the seminar/practicum offers opportunities to engage in sustained critical inquiry, analysis, or problem-solving in a focused thematic area.
- *Research and investigation:* to engage students in research, discovery, creativity, or investigation, the seminar/practicum provides opportunities for students actively and critically to seek and evaluate new information and insights using multiple sources. These opportunities need not necessarily be research papers.
- *Communication and writing*: to develop each student's ability to communicate effectively both orally and in writing, the seminar/practicum includes discussion of appropriate communications skills and provides opportunities to revise written work after receiving feedback from the instructor.
- *Intellectual independence*: to foster independence of thought, the seminar/practicum offers significant opportunities for individual, self-directed work.
- *Conversation and dialogue*: to promote individual reflection and the appreciation of diverse perspectives, the seminar/practicum consists of classroom activities other than traditional lecture to encourage discussion and collaborative learning in a spirit of openness, cooperation, and dialogue with peers. The thematic focus, structure, and assignments for each seminar or practicum are to be determined by each individual instructor to achieve these goals.

Inquiry Seminar

The Inquiry Seminar, usually taken in the sophomore year, represents the culmination of the Humanities and Arts Requirement. The Seminar provides an opportunity for students to explore a particular topic or theme in the humanities in greater depth. The Seminar has two primary goals. The first is to foster independence of student thought, typically through some form of self-directed activity. The second is to encourage a cooperative, dialogic approach to inquiry, through open exchanges with peers in a small, intensive classroom setting (typically 12 students or fewer). Students learn how to frame questions in the context of a particular discipline or field of study, and to explore or investigate problems using methods appropriate to work in the humanities and arts.

As the student's capstone experience in the humanities and arts, the Inquiry Seminar is intended to help students take their knowledge of the humanities to a higher level. The purpose of the Inquiry Seminar, therefore, is not to provide a broad survey or general introduction to a given discipline, but to provide a structured forum in which students might approach a specific humanities-related problem or theme at a deeper, more sustained level of intellectual engagement than would normally be possible within a traditional course setting. The pedagogical idea behind the Inquiry Seminar is that work in the humanities and arts is at once an intensely personal enterprise, in which the individual freely draws on her or his own particular interests, abilities, passions, and commitments, and at the same time a form of ethical community in which the practitioner is always in conversation with and accountable to others.

While the specific content and requirements of the Inquiry Seminar vary from instructor to instructor, all Inquiry Seminars incorporate self-directed learning as a significant part of the curriculum. It is the department's expectation, therefore, that by the time they enroll in the Seminar, students should have sufficient background in the humanities and arts to be able to work independently and to pose questions of their own. Students will be asked to research and write a term paper, to assemble a portfolio of writings or exercises, or otherwise to demonstrate their ability to pose a question of relevance to humanities inquiry, and to answer it. At the same time, the Seminars are designed to foster an atmosphere of intellectual collaboration and discovery. Students are required to participate fully in seminar discussion, to share the results of their own research or activities, and to engage the ideas and interests of their peers in a constructive and collegial way.

Practicum in Humanities and Arts

Students in the performing arts have the option to complete their Humanities and Arts sequence with an Inquiry Practicum in music or theatre. A practicum shares the same goals and objectives of an inquiry seminar but provides students with a production/performance experience which emphasizes the hands-on, practical application of skills and knowledge gained from previous Humanities and Arts courses. Samples of practicums in music include composing, arranging, or performing a solo recital. Theatre students may choose to work on a campus production in a number of production roles, including but not limited to acting, directing, dramaturgy, design, technical production, or management. In addition to weekly meetings, students may be required to attend rehearsals, performances, and other production-related activities. The design of the final project is determined through conversations between instructors and students. Due to the unique nature of the practicum, permission of the instructor is required to enroll in a practicum.

Languages: Practicum or Seminar

Students in languages may complete the Humanities and Arts Requirement in one of the following three ways:

1. *Practicum in the sixth and final course in a language*. The practicum will include evaluative components or exams to demonstrate overall language skills in four areas: listening, speaking, reading, and writing. The practicum will require students to demonstrate breadth of cultural knowledge of the language area. (Examples of practicum courses: CN 2544, CN 3544, GN 3512, GN 3515; SP 3522; SP 3527)
2. *Advanced language seminar after five previous courses in the language*. The seminar will explore a thematic topic and provide opportunities for individual inquiry. (Seminar examples: GN 3513, GN 3514; SP 3523, SP 3524, SP 3525, SP 3526, SP 3528, SP 3529, SP 3530, SP 3531)
3. *Advanced language seminar after advanced-level language courses combined with courses from other areas of study*. Students who demonstrate basic oral, written, and cultural knowledge of a language in a placement test at the advanced level may combine courses from other areas for their requirement. (Seminar examples are the same as option 2.) International students who are non-native speakers may take a combination of ISE and WR courses and fulfill the HUA requirement by taking a 3000-level or above ISE/WR project-based course.

Option 1 and 2 require students to take six courses in a language. For example, in option 1, a student without prior language training might begin with GN 1511 Elementary German I and conclude with a practicum in GN 3512 Advanced German II. In option 2, for example, a student might start with SP 2521 Intermediate Spanish I followed by five Spanish courses which culminate in one of the designated seminars. In option 3, students who demonstrate knowledge of the language at the advanced level may mix courses from other areas in their course sequence. For example, a student might take two courses from history, philosophy, music, etc. along with four advanced Spanish courses which would culminate in a designated seminar. Students in the English language track might begin with three ISE courses, take one WR course, one from history, and conclude with a

3000-level ISE/WR course. Students in all three options for languages would be required to submit the same materials to demonstrate completion of the requirement as students whose culminating experience was an inquiry seminar or practicum in another area of the Humanities and Arts.

HUA Faculty Arranged by Disciplinary Group

Art/Art History (AR)

Roshanak Bigonah (AR)
Jennifer deWinter (AR)
Adryen Gonzalez (AR)
Edward Gutierrez(AR)
Marie Keller (AR)
Jo Ellen Reinhardt (AR)
Joshua Rosenstock (AR)
M. David Samson (AR)

Music (MU)

Scott Barton (MU)
Fred Bianchi (MU)
V.J. Manzo (MU)
Douglas Olsen (MU)
Joshua Rohde (MU)
Douglas Weeks (MU)
Brent Wetters (MU)

Theatre (TH)

Patrick Crowe (TH)
Laura Eckelman (TH)
Sarah Lucie (TH)
Kathryn Moncrief (TH)
Olivia D'Ambrosio Scanlon (Adjunct)
Steve Taylor (OBC/TH)

Languages (AB, CN, GN, ISE, SP)

Esther Boucher-Yip (ISE))
Althea Danielski (ISE)
Daniel DiMassa (GN)
Wen-Hua Du (CN)
Mohammed El Hamzaoui (AB)
Aarti Madan (SP)
Ingrid Matos-Nin (SP)
Angel Rivera (SP)

Lina Munoz-Marquez (SP)
Huili Zeng (CN)

Literature/Writing (EN,WR)

Joe Aguilar (EN)
Esther Boucher-Yip (ISE, WR)
Kristin Boudreau (EN)

Joel Brattin (EN)
Jim Cocola (EN)
Althea Danielski (ISE, WR)
Jennifer deWinter (WR)
Mohammed El Hamzaoui (AB, WR)
Michelle Ephraim (EN)
Brenton Faber (WR)
Joshua Harmon (EN, WR)
Shana Lessing (WR)
Kevin Lewis (WR)
Ryan Madan (WR)
Katherine McIntyre (EN, WR)
Svetlana Nikitina (EN, HU)
Lance Schachterle (EN)
Yunus Telliel (WR)

History/International and Global Studies (HI, HU, INTL)

Bland Addison (HI, INTL)
Steven Bullock (HI)
Constance Clark (HI)
Joseph Cullon (HI)
Lindsay Davis (HI)
Holger Droessler (HI, INTL)
John Galante (HI, INTL)
James Hanlan (HI)
Peter Hansen (HI, INTL)
Shana Lessing (HI, INTL)
Jennifer Rudolph (HI, INTL)
William San Martin (HI, INTL)
David Spanagel (HI)

Philosophy/Religion (PY, RE)

Bethel Eddy (PY, RE)
Roger Gottlieb (PY, RE)
Jennifer McWeeny (PY)
Rebecca Moody (PY, RE)
Geoff Pfeifer (PY, RE)
John Sanbonmatsu (PY)

AP Credit Policy

The Humanities and Arts Department will accept a maximum of 1/3 unit of AP credit towards the Humanities and Arts requirement. Students who score a 4 or 5 on the AP test in German or Spanish automatically receive 1/3 unit of credit in the language, provided they do not begin German or Spanish study at WPI with Elementary German I (GN 1511) or Elementary Spanish II (SP 1523). Students who score a 4 or 5 on the AP test in studio art may be eligible for HUA credit, subject to a portfolio review by art faculty. Students who score a 4 or 5 on the AP test in other subject areas of the humanities and arts will receive credit in the relevant discipline. AP credit beyond one course (1/3 unit) in the Humanities and Arts may be counted toward other requirements such as free elective credit or particular majors and minors at WPI.

Transfer Students and the Humanities and Arts Requirement

Students who transfer fewer than six Humanities and Arts courses from another institution must complete an inquiry seminar or practicum to complete the Humanities and Arts Requirement. Students who transfer six or more courses in Humanities and Arts will have the option of submitting a CDR form or engaging in additional work (or documentation of work) to earn an “A” on the CDR, in accordance with current transfer rules (see below).

All students may have the option of completing their Humanities and Arts Requirement while enrolled for 1 unit of coursework at an off-campus project center where one-third unit of the coursework shall include an inquiry seminar or practicum.

Transfer credit in the Humanities and Arts at WPI is granted on a course-for-course basis. All Transfer students entering WPI with *fewer than six courses or their equivalent of transfer credit in the Humanities and Arts* must complete work in the Humanities and Arts, including an Inquiry Seminar/Practicum to the extent that the overall Humanities and Arts credit totals two units.

No credit toward the Humanities and Arts Requirement is given for introductory-level foreign-language courses unless the entire program is in that foreign language. Usually only one transfer course in Freshman English can be applied toward the requirement. In all cases, the professor for the Inquiry Seminar/Practicum has the final decision on what courses are acceptable within the student's sequence leading up to the project. Up to one unit (i.e. three courses) of transferred work in the Humanities and Arts that is not credited toward the Humanities and Arts Requirement can be credited toward the fifteen-unit graduation requirement; such courses shall receive credit under the category of EL 1000.

If a Transfer student *has completed two units of acceptable college-level work in the Humanities and Arts prior to entering WPI*, a Completion of Degree Requirement form will be submitted by the Humanities and Arts Department Coordinator for Transfer Students at the request of the student. The grade for such a Humanities and Arts Requirement met by transfer credit is normally a grade of "CR". Students whose grades on transferred courses average A can engage in additional work or submit samples of their previous work and may be awarded an A for the Humanities and Arts Requirement. Alternately a transfer student may elect to undertake an Inquiry Seminar/Practicum in an effort to achieve an A grade. These evaluation options must be exercised prior to the Department's submission of the Completion of Degree Requirement form to the Registrar.

Decisions concerning credit toward the Humanities and Arts Requirement are made by the Humanities and Arts Coordinator for Transfer Students, Professor James Hanlan. He can be contacted in room 28 of Salisbury Laboratories, or at extension 5438, or email jphanlan@wpi.edu.

Guidelines for Granting Transfer Credit to U.S. Students for Foreign Language Study

Beginning with students matriculating for spring semester/January 2024

1. **Grade needed for transfer credit**

HUA currently requires a B or better from accredited 2-year institutions and a C or better from 4-year accredited institutions. Recommendation: B- or better from accredited US institutions. Non-US institution will be considered on a case-by-case basis.

2. **Credit for language classes at other institutions**
    A. **Credit for study on the high school level:**
        1. Transfer credit of 1/3 unit is given for Advanced Placement with a score of 4 or 5.
        2. Students with three or more years of modern-language study in high school, but who have not taken the Advanced Placement examination in that language, may receive 1/3 unit credit for their high school language study upon satisfactory completion of two courses in the same language on the intermediate level or above. (Note: Courses in Chinese, German and Spanish in addition to those offered at WPI, as well as courses in other languages, are available at other colleges in the Consortium.)
        3. In either case 1. or 2. above, in order to receive 1/3 unit credit, students must begin their WPI course sequence at the Elementary II level or above.
    B. **Credit for study at other colleges and universities:**
        1. Language study which is done at other US universities and colleges prior to entering WPI, transfers on a course-for-course basis with a minimum grade of B- This course credit can count towards the student's Humanities and Arts requirement.
        2. Language study which is done at universities, language institutes, or cultural institutes outside the US, prior to entering WPI, or done with the prior written permission of the Department Head

as part of an agreed-upon Humanities and Arts sequence, is assessed by the relevant language faculty based on the grade earned, number of contact hours, instructional format, institution, and the level of work accomplished.

3. **Credit for online courses**

For entering transfer students, HUA will accept online course credit from accredited institutions in the U.S. (international institutions will be reviewed on a case-by-case basis) that can be used to satisfy the HUA requirement.

Other Options

Interdisciplinary Study at the American Antiquarian Society

A unique opportunity for interdisciplinary work in the humanities and arts is offered by the American Studies Seminar sponsored each fall by the American Antiquarian Society. Organized in collaboration with Worcester's five undergraduate colleges and universities, this seminar focuses on topics that allow students to investigate the Society's rich holdings in early American history, literature, and culture. The Society's unparalleled collection of documents is a short walk from the campus. Information on application deadlines and academic credit toward the Humanities and Arts Requirement is available from the WPI Campus Representative to the American Antiquarian Society.

Off-Campus Option: Humanities and Arts Project Centers

WPI offers the option to complete the Humanities and Arts Requirement during one term of study at several Project Centers. Normally, students complete the requirement through at least six courses or independent-study projects on campus. However, the "Off-Campus" option allows students to combine at least three courses on campus with one term studying the humanities and arts at a Project Center. Students may use this option to complete the requirement.

Off-campus projects are available in Germany and Argentina for the study of foreign languages and in England, Taiwan, Japan, and Morocco for other fields. Students devote themselves to one term studying the history, literature, language, or culture at the project center with a WPI faculty advisor. The program might combine a thematic seminar in an area of the faculty advisor's expertise with visits to museums, the theatre, musical performances, or cultural excursions. Although themes or areas of emphasis vary from year to year, all off-campus Humanities and Arts activities culminate in a written report in an area of interest to the student.

To be eligible for participation, students must have already completed three courses in humanities and arts before they leave campus. Students may apply to the off-campus program before they have taken all three courses. In addition, students going to any Project Center must complete all of the forms required by the Interdisciplinary and Global Studies Division.

Requirements:

- Students must have completed at least three courses in the Humanities and Arts at WPI, or have earned equivalent course credit approved by the Humanities and Arts Department, before the term of the off-campus activity. The Department may allow students to count transfer or advanced placement credits toward the three course minimum;
- Students must be accepted into the off-campus Humanities and Arts program by the Humanities and Arts Department, and complete all forms required by the Interdisciplinary and Global Studies Division, in order to register for these projects.
- Students might be required by the faculty advisor to complete a PQP or attend required meetings before the off-campus project;
- Students must submit a written report or paper at the end of the program. Students also may be required to submit written updates at various times in the course of the program. In all cases, the faculty advisor at the project center will determine the precise form of the written requirements.
- Students may be required to give an oral presentation at the end of the program;
- Under normal circumstances, students must complete the program within one term in order to receive the full unit of credit;
- Only members of the Humanities and Arts faculty at WPI may advise off-campus Humanities and Arts programs.

Off-Campus Recommendations

All off-campus programs benefit from advance planning. Discuss the possibility of an off-campus activity with your academic advisor at the beginning of the freshman year. Consult with the WPI faculty who will advise these off-campus programs as early as possible, since they may be able to suggest useful courses or other background resources for the projects. Also keep in mind that three courses are the minimum required, but many students find it advantageous to take additional courses before going away.

The interdisciplinary programs are open to students with a background in areas of the humanities and arts besides foreign languages, including art history and architecture, drama/theatre, history, literature, music, philosophy, religion, or writing/rhetoric. After taking at least three courses in any of these areas on campus, you could then go to a HUA project center to complete your requirement. Some students also have participated in this program to study beyond the Humanities and Arts Requirement for a minor in international and global studies, history, literature, music, theatre, or other areas.

The Humanities and Arts Department advertises upcoming program locations and application deadlines at the Global Fair each September. Future programs might include other locations that provide the context for an intensive study of humanistic themes associated with particular locales within the United States. Contact the Department of Humanities and Arts for more information.

The Social Science Requirement

The goals of the Social Science Requirement are to give students the opportunity to:

1. Study human society, including human thought and behavior, politics, ethics, human-environment relationships, public policy, economics, and technology;
2. Learn to think critically about social issues and problems, particularly those at the interface of society and technology;
3. Become inspired and develop the skills necessary to help solve social problems throughout their academic and professional careers.

What Counts

Any two courses taught in the Social Science & Policy Studies Department may be counted toward the Social Science Requirement, including all courses with one of the following prefixes: ECON, ENV, DEV, GOV, PSY, SD, SOC, SS, STS.

One-third unit of a Great Problems Seminar course may be counted, but only if the GPS is co-taught by a faculty member with at least a half-time appointment in the SSPS Dept.

The project preparation course SS/ID2050 may be counted toward the Social Science Requirement. However, we recommend that students use the requirement to fully explore their interest and develop a knowledge base in one or more of the following social science disciplines: economics, environmental studies, political science & law, psychology, system dynamics, or science, technology, and policy.

Students interested in obtaining WPI credit for a social science course taken at another institution should consult our transfer credit authorization policies and procedures available at: https://www.wpi.edu/academics/study/programs/social-science-policy-studies/resources

What Doesn't Count

Courses taught in the Humanities & Arts Department or the School of Business do not count toward the Social Science Requirement. Courses taught in STEM Departments or programs that address social implications (e.g., CS 3043, IMGD 2000) do not count. The course ID 3100 does not count.

Why Stop at Two Courses?

The Department of Social Science and Policy Studies has a variety of majors and minors that will contribute to your WPI experience, improve your career prospects, and provide additional perspective to your degree. Reach out to a faculty member to determine which minor or major is right for you.

Depth or Breadth?

The requirement allows students a choice of focusing on depth or breadth in the social sciences. Students who are unsure which social science disciplines are of most interest or value to them may use the requirement to explore two different areas. For example, students may take one course in economics and another in psychology, or one in environmental studies and another in government/policy. Students who have more defined interests may focus on depth, taking both an introductory and advanced course in the same discipline (e.g. Introduction to Environmental Studies and Environmental Problems in the Developing World). Students are welcome to contact the various program directors to learn more about the different social science courses.

When

We recommend that students complete the 2-course Social Science Requirement prior to beginning their IQP. The social science courses can help students identify interests and make more informed and rewarding choices for their IQP project. They will also provide social science knowledge and analytical skills that can enable projects to succeed.

Double Counting

Courses taken to fulfill the Social Science Requirement may overlap with the distribution requirements of any major. For example, students majoring in Management are required to take two courses in economics. Those two courses can count toward both the Management major and the Social Science Requirement.

Questions?

Questions about the Social Science Requirement may be directed to our Social Science Requirement Coordinator, Prof. Lisa Stoddard (eastoddard@wpi.edu, X5284, 310F Salisbury Labs).

Want more? How about a social science minor? (You're 2/3 of the way there!)

The Social Science Requirement calls for a minimum of two courses. But students who want to *bring depth to their WPI experience and their resumes* are encouraged to use their free electives to pursue additional courses or a minor. If the two courses that count toward the SS requirement are in the same discipline, only 4 additional courses are required to obtain a minor in economics, environmental studies, psychology, law & technology, or system dynamics. For more information or questions about minors, see one of the following program liaisons:

Economics: Prof. Alex Smith (adksmith@wpi.edu, X6543, 310B SL)

Environmental Studies: Prof. Laureen Elgert (lelgert@wpi.edu, X5110, 223C SL)

Global Public Health: Prof. Angela Rodriguez (acrodriguez@wpi.edu, X5787, 317B SL)

STP: Prof. Crystal Brown (cbrown2@wpi.edu, X5163, 332 SL)

Psychology: Prof. Jeanine Skorinko (skorinko@wpi.edu, X5451, 317D SL)

System Dynamics: Prof. Oleg Pavlov (opavlov@wpi.edu, X5234, 310A SL)

Wellness and Physical Education Requirement

Wellness and Physical Education Requirement

To provide an understanding and experience in Wellness and Physical Education to gain awareness for lifelong well-being to thrive personally and professionally, every student must complete a Wellness & Physical Education requirement.

Qualification in wellness and physical education shall be established by completing 1/3 unit of course work. Students may take classes multiple times for credit. We do not offer independent study options in Wellness and Physical Education. In addition to PE 1000-series course offerings, students may satisfy their PE requirement by the following:

1. WPI approved varsity athletic team participation (PE 2000-series). Student must be registered with instructor permission in advance of participation. No retroactive credit will be awarded if failure to register.
2. Club Sports (PE 1200-series). Students must be members of a PE approved club prior to becoming eligible for physical education credit and by meeting established department policies for credit. Students must be registered in advance of participation; no retroactive credit will be awarded if failure to register in advance. Additional fees for some clubs may apply.
3. Approved courses not offered at WPI; advance approval by the Physical Education Department is necessary so students are encouraged to contact the department directly in advance to review. No retroactive credit will be awarded if failure to receive advance approval.
4. Participation in certain ROTC programs may entitle students to a receive PE credit. Students in ROTC programs should review in advance with their respective commanders.

GENERAL PHYSICAL EDUCATION COURSES
(PE 1000 series)

This series is offered to provide a variety of courses in the more traditional sport-based area of physical education. These courses can serve the beginner to the more experienced in each activity area. PE 1000 series courses meet twice a week (generally between 8am-5pm) at predetermined times with attendance and participation major factors in a student's final grade.

HEALTHY ALTERNATIVE PHYSICAL EDUCATION COURSES
(PE 1099)

These PE courses are offered to provide a variety of wellness, dance and healthy alternatives to traditional PE sport-based classes. These classes are subject to change on a yearly basis in order to provide flexibility in the PE offerings based upon the latest trends in wellness and dance. The focus of these classes is more on individual fitness, wellness and education, with instruction provided to all students in the classes.

THE CLUB SPORTS PROGRAM (PE 1200-series)

Club Sports are activities in various sports and wellness that are organized and recognized by Student Government Association as Class II organizations and open to any undergraduate student. Students who are properly registered in advance for the club activity in their interest area (more information regarding Club Sports can be found at wpi.edu/+techsync) and meet the established criteria for participation by the club as well as by PERA department policy, may be eligible for PE course credit. Practice and/or competition times vary but are generally in the evenings and weekends. Participating students may incur additional fees for equipment, travel, and/or uniforms.

Individually Sponsored Residential Projects (ISRPs)

Through the Individually Sponsored Residential Projects (ISRP) process, faculty may design custom off-campus projects in addition to the established options available at WPI Project Centers. ISRPs are subject to an approval process through the DIGS that includes routine planning and risk management protocols employed for the Global Projects Program.

Consult the Global Portal at https://www.wpi.edu/+globalportal for ISRP Process Deadlines. Please contact DIGS at global@wpi.edu with any questions about the ISRP process.

Individually Sponsored On-Campus IQP Programs

Energy Sustainabilty Project Center

Director, Professor Paul Mathisen, Kaven Hall 209E

This center supports and helps to coordinate project work (both MQPs and IQPs) in all aspects of energy and across all areas of academic inquiry at WPI. A goal is to promote the use of innovative technologies and approaches to meet on-campus, regional, and global energy challenges. The principles of sustainability, with consideration to economics, the environment, and social justice, are emphasized in all of the Center's activities. The Center's objectives are to

support and to facilitate the organization of project teams and advisors to address problems involving sustainability and energy. Areas of interest range from traditional and renewable forms of energy to the use of systems approaches to address the relationships between energy and societal needs such as buildings, transportation, food and water. Center activities include the following: communication of WPI's activities in the energy area both internally and externally; establishment of a clearinghouse for project topics and the formation of project teams; organization of a forum for discussion of major energy-related topics, highlighting excellent energy-related projects; and identifying externally-sponsored projects. For more information contact Prof. Paul Mathisen (mathisen@wpi.edu).

STEM Education Project Center

Director, Kathy Chen

The heart of the STEM Education Project Center is captured in the quote by Leila Janah, "Talent is equally distributed but opportunity is not." Projects associated with this Center focuses on transforming PreK-12 Science, Technology, Engineering, and Mathematics (STEM) education to be high-quality, equitable, and culturally relevant. With the goal of improving PreK-12 STEM education opportunities for all children, our objectives include: 1) providing engaging and inclusive STEM activities to diverse audiences, 2) examining the educational opportunity gaps in different contexts, and 3) supporting informal and formal educators in STEM. Some projects may be to design, develop, and test hands-on, standards-aligned, PreK-12 STEM; to examine STEM education in a global context; and to develop sustainable relationships between WPI and local non-profits around STEM opportunities. In addition, the teaching practicum requirement in the Teacher Preparation Program is typically done as an IQP during A&B or C&D terms. These projects (MQPs and IQPs) are in partnership with the STEM Education Center at WPI and PreK-12 schools, afterschool programs, non-profits, and educators. Faculty are invited to bring projects under the STEM Education Project Center. For more information, please contact Kathy Chen (kcchen@wpi.edu) and go to https://www.wpi.edu/+stem.

Sustaining WPI Project Center

Co-Directors, Suzanne LePage and Derren Rosbach

There is a great deal of interest in enhancing the sustainability of WPI – both as an institution and as a campus. The Sustaining WPI Project Center was developed to support and coordinate project work (primarily IQPs) developed around these interests. Project topics are proposed by the project teams based on their sustainability interests and in coordination with faculty advisors and the WPI Office of Sustainability. The intent is to address all aspects of sustainability as outlined in the WPI Sustainability Plan: campus facilities, the educational curriculum, research and scholarship, as well as civic engagement. The Center sponsors IQPs in D-term each year with student preparations beginning in C-term. For more information contact Suzanne LePage (slepage@wpi.edu).

Courses Qualifying for Engineering Distribution Areas

Mathematics

All Courses designated “MA.”
Advanced placement established by AP exam or through passing WPI advanced courses (see page 243) also qualify.

Basic Science

All courses designated “PH,” “CH,” “BB,” and GE 2341.

Engineering Science/Design

The following courses may be applied to the “Engineering Science and Design” distribution requirement for each respective engineering major:

AE: All courses designated “AE”

BME: All courses designated “BME” (except BME 1001, BME 1004, BME 3110, BME 3112, BME 532, BME 560, BME 562, BME 564, and BME 593; BME 595 requires departmental approval) and CE, CHE, ECE, RBE, and ME courses at the 2000-level or above (except RBE 3100).

CE: All courses designated “CE”. Also ES 2503 and ES 3004.

CHE: All courses designated “CHE.” Also ES 3002, ES 3003, ES 3004, and other courses approved by the Chemical Engineering Department. See the department web site, and consult with your academic advisor for details.

ECE: All courses designated “ECE” and ES 3011 may be included in the six-unit ECE area distribution requirement.

IE: OIE courses including OIE 2081, OIE 2600, OIE 2850, OIE 3020, OIE 3405, OIE 3410, OIE 3420, OIE 3460, OIE 3510, OIE 4410, OIE 4430, OIE 4460, MIS 3720, MIS 4084, MIS 4720 and MIS 4741.

ME: All courses designated “ME”.

RBE: All courses designated (except RBE 3100).

In addition, engineering majors selecting “Engineering Science/Design” courses from outside their major may choose appropriate activities from any of the following:

All courses designated ES, ECE, CHE, ME.

All OIE courses listed above (for ME majors only).

All courses designated as RBE except RBE 3100.

All courses designated as CE except CE 3022.

All courses designated as CS except CS 1101, CS 1102, and CS 3043. (Only RBE majors may select CS 1101 or CS 1102 to satisfy the Engineering Science and Design Distribution Requirement.)

(Electrical and Computer Engineering majors are restricted to these courses at the 2000-level or higher.)

All ABET engineering programs require six units of Engineering Science and Design.

All graduate-level courses may be counted in the appropriate categories.

University Procedures

Administrative Obligations and Holds

The college reserves the right to hold grades, transcripts, registration and/or diploma for any student who has an outstanding administrative obligation with the college.

Early Completion

Students completing 100% of WPI graduation requirements by the end of A-term or C-term will be eligible for a 50% tuition adjustment for the semester of completion. Eligible students must complete the form available in the Registrar's Office and submit by the end of B-term (for C-term completion) or D-term (for A-term completion). Students/responsible parties will be billed for the full semester and then tuition charges will be reduced by 50% once the graduation requirements have been signed off and the student's withdrawal has been officially processed. Qualified students receiving financial aid from WPI will retain 50% of any WPI scholarship, and their loan eligibility will be reviewed on an individual basis. Students living in WPI housing will still be financially responsible for paying the full semester's worth of room and board.

Students are permitted to enroll in a maximum of 4/3 units (12 credits), excluding PE, in either A or C term. Students registered beyond 4/3 units will be charged the overload fee.

Double Major

Distribution Requirements

The distribution requirements of each major must be met, but requirements common to both majors may have to be met only once. A minimum of three units of qualifying project work is thus required for fulfillment of the project portion of the double major requirements: one unit in each of the two major areas of study, and one unit of an IQP.

For students wishing to pursue double majors not involving social science, the program audit for each intended major must be completed and certified by the review committee of each department involved. Academic activities appropriate to both majors may be counted in both majors..

If a student wishes to complete two Interdisciplinary (individually designed) Majors Programs, the double major must be proposed in a single Educational Program Proposal, which must be approved by the student's Program Advisory Committee for each major. The Committees shall ensure that the majors are substantially non-overlapping.

If a student's double major includes an Interdisciplinary (individually designed) Major Program, the double majors must be described in the Educational Program Proposal for the Interdisciplinary Major.

Designation of Class Year

Class year will normally be designated as year of matriculation plus four with the additional requirement that the accumulation of 34/3 units is necessary for fourth-year status, 22/3 units for third-year status, and 10/3 units for second-year status. The class year of transfer students will be determined on an individual basis. Class year designations will be reviewed at the end of Term E each year and changed if the credit accumulation does not meet the above specifications. After Term E, students may petition to be redesignated in their original class if they meet the minimum unit requirements.

Directory Information and Release of Information

The items listed below are designated as "Directory Information" for each student: campus mailbox, full name, year, major, advisor, e-mail address, permanent address, local address, local phone, photograph, date and place of birth, dates of attendance, enrollment status, degrees and awards received, and most recent or previous educational agency or institution.

Under the provisions of the Family Educational Rights and Privacy Act of 1974 (FERPA), the institution is permitted to release Directory Information without a student's consent. A student, however, has the right to restrict the disclosure of any or all of their Directory Information. Written notification to withhold Directory Information must be received by the Registrar's Office during the first week of the fall semester/A term. Forms are available in the Registrar's Office or on the Registrar's website. A request to restrict the disclosure of Directory Information does not restrict internal use of such by the institution.

Unless a student notifies the Registrar's Office in writing to the contrary, the college considers all undergraduate students to be dependents of their parents. In compliance with the Family Educational Rights and Privacy Act, the college reserves the right to disclose information about the status of dependent students to their parents without the students' written consent. Petition forms for Declaration of Independent Status are available in the Registrar's Office upon request (see information under Distribution of Grades).

Policy on Releasing Information on Deceased Students

The education records of deceased students may be released or disclosed, at the time of death, upon written request, to a spouse, a parent, the executor of the estate, the eldest surviving child, the eldest surviving sibling, and surviving descendent, or pursuant to a court order or subpoena. Only the Registrar may release the academic records of deceased students. The person requesting the records must provide as much of the following information as possible within the written request:

Student's name (and maiden name, if applicable).
Student's Social Security number.
Student's date of birth.
The dates that the deceased student attended WPI.
Death Certificate (Photo copy is acceptable).
The petitioner must also provide the following personal information within his/her written request:

- Name.
- Address.
- Phone Number.
- Evidence that he/she is qualified to receive the records, based on the above criteria or, in the absence of evidence, a statement certifying the same.
- Signature.
- Date of request.

Off-Campus Programs

All off-campus programs offer students the opportunity to complete a project in one term of full-time work. Advance preparation is required. Faculty advisors are in residence at IQP sites and some Humanities and Arts and MQP sites.

More details about current off-campus program offerings, including an up-to-date list of program locations can be found on eProjects. Find a listing of all global project centers here.

Academic Standing

Satisfactory Academic Progress

In order to assist the student, parents, and the academic advisor in determining whether a student is making academic progress, WPI has adopted the following guidelines.

To maintain Satisfactory Academic Progress, a student must:

1. Complete at least 4/3 units of academic work for the fall semester (A and B terms); and
2. Complete at least 4/3 units of academic work for the spring semester (C and D terms).

Note: Air Force Aerospace Studies (AS), Military Science (ML), and Wellness and Physical Education (WPE) courses are not included in any evaluation of Academic Progress.

Academic Progress is evaluated at the end of each semester and any student who does not maintain Satisfactory Academic Progress will move down one level of academic standing (to warning, from warning to probation, or from probation to suspension). First-year students who earn no academic credit (see note above) during their first two terms at WPI will be placed on Academic Suspension. Thereafter, any student who earns no academic credit in a semester will move down two levels in academic standing.

Academic Warning

Each student's academic record will be reviewed at the conclusion of terms B and D according to the guidelines above. If a student's performance falls short of either guideline 1 or 2, the student will be placed on Academic Warning for two terms. At this time, the student is urged, with the help of the advisor, to identify the nature of the academic difficulty and to formulate a course of action for overcoming the difficulty. Students on academic warning may apply to the Global Projects Program, but WPI reserves the right to withdraw acceptance to students who are subsequently placed on academic probation.

Academic Probation

During the next review of academic progress, should the student fail, once again, to maintain satisfactory academic progress, the student will be placed on Academic Probation for two terms. Academic Probation will prevent the student from receiving financial aid, will result in loss of eligibility for team sports, will prevent the student from obtaining undergraduate employment in the Co-op Program and will prevent participation in the Global Projects Program.

Academic Suspension

Should a student on Academic Probation fail to make satisfactory academic progress during the next review period, the student will be *suspended* from WPI. This status will prevent the student from enrolling as a full-time student *or* a part-time student for at least the next two terms. Subsequent readmission is subject to approval (with possible conditions) of a petition through the Registrar to the Committee on Academic Operations (CAO). As a general rule, a student readmitted after suspension will be placed on an Academic Probation status.

New students (first year or transfer) who fail to obtain academic credit for the first two terms shall be placed on Academic Suspension and not allowed to enroll for the following two terms. To apply for readmission, a student must submit a petition to the Committee on Academic Operations (CAO).

Improvement in Status

Students on Academic Warning or Academic Probation have the opportunity to improve their status by progressing through the levels in reverse order. If a student on Academic Probation satisfactorily meets the guidelines at the end of the next review period, he or she will be moved to the list of students on Academic Warning. A student on Academic Warning would be moved back to Satisfactory Academic Progress status.

Summer Review Period

An exception to the guidelines stated above can occur when a student registers for Term E. At the conclusion of Term E, a review will be conducted which will include E-term and the previous four terms. If the student has completed 10/3 units acceptable work, the student's academic progress status will improve. Thus, a student on Warning status after the Term D review will start terms A and B on Satisfactory Academic Progress. A student placed on Academic Probation after the Term D review will be on Warning status for terms A and B.

Summer Academic Success Program

Students who finish the academic year on Academic Warning or Academic Probation status, but who have passed at least 2 units of academic work during the previous four terms, are eligible to participate in the Summer Academic Success Program. Students who participate in the program enroll in ID 1000- Summer Academic Success Program, a five-week academic skills course, as well as two E Term courses. Successful completion of the courses and ID 1000 will result in the academic status rising one level (Academic Probation to Academic Warning, or Academic Warning to Satisfactory Academic Progress). The Office of Academic Advising coordinates the Summer Academic Success Program.

Part-time Students

Students pursuing the bachelor's degree as part-time students will be subject to the same review schedule and standards as full-time students. All part-time students will be reviewed after the Fall and Spring semesters and must satisfactorily complete at least one-third of the academic activities for which he/she has registered. For more information on part-time status, click here.

Grade Changes and Academic Status

Students who are placed on Academic Warning or Academic Probation at the end of a given semester may receive a grade change (either incomplete to letter or letter to letter) that may improve the standing. The Registrar will re-review a student's standing if the grade change comes in by the last day of the immediately following term. Please note that, depending on the timing of this re-review, the improved standing may not have an effect on financial aid implications. This option is not available to students on suspension. Suspended students must petition the Committee on Academic Operations for reconsideration or to return from suspension.

Petitions

Students may petition through the Registrar's Office to the Committee on Academic Operations (CAO) for reconsideration of the status of the following:

- Academic Probation
- Academic Suspension
- Readmission after Suspension

Students who petition for reconsideration of status must accomplish the following:

1. Obtain a petition form from the Registrar's Office webpage.
2. Complete the form and obtain advisor's approval and signature.
3. Submit the form to the Registrar's Office within three weeks of the issuance of grades for B, D, or E term reviews except for readmission after suspension.

Deadlines for Readmissions after Suspension

July 20 for Term A

November 15 for Term C

Registration and Enrollment

Registration

During the spring, students will receive information regarding course offerings for the following academic year. After consulting with academic advisors, students will make course selections via the online registration system. Students with holds will be prevented from registering until the obligation is met.

A calendar is published by the Registrar's Office prior to the add/drop period which specifies the time periods and fees for late changes. Students are responsible for the dates and should contact the Registrar's Office if they need information to avoid late fees. Requests for exceptions to published deadlines must be submitted in writing to the Registrar's Office and will be granted based on documented extenuating circumstances, i.e., medical, military obligations.

Course Changes

There is an add/drop period at the start of each term and the exact deadlines depend on the length of the course session (7, 10, or 14 weeks).

For 7-week courses (undergraduate and graduate), a student can add a course without a fee through the fifth day of classes. On the sixth through the tenth day of classes, students can add courses (with instructor approval) with a $100 late fee. Students can drop courses on days 1-10 of each term without incurring a late fee. For undergraduates in 7-week courses, no adds or drops are allowed after the tenth day of the term. For graduate students in 7-week courses who drop a course after the tenth day, but before the end of the fifth week of the term, a W (Withdrawal) will be assigned. No tuition or fees will be refunded after the tenth day of the term.

For 14-week courses (undergraduate and graduate), students can make course changes (add or drop) without penalty through the tenth day of the semester. A $100 late fee will be charged for course adds after the tenth day of the semester and instructor permission is required. No drops are allowed after the tenth day of the semester; for graduate students, course withdrawals are permitted through the tenth week of the semester, and a grade of W (Withdrawal) will be assigned. No tuition or fees will be refunded after the tenth day of the semester. Consult the University calendar for specific dates.

For 10-week courses (undergraduate and graduate), students can make course changes (add or drop) without penalty through the tenth day of the semester. A $100 late fee will be charged for course adds after the tenth day of the semester and instructor permission is required. No drops are allowed after the tenth day of the semester; for graduate students, course withdrawals are permitted through the seventh week of the semester, and a grade of W (Withdrawal) will be assigned. No tuition or fees will be refunded after the tenth day of the semester.

Note: If a degree-seeking student is dropping or withdrawing from all registered course activity, they must either take an institutional leave of absence or officially withdraw from the University.

Wait Lists

When a seat in a class becomes available to a student on the wait list, they will be notified via e-mail. The e-mail contains instructions on how to claim the available seat. If a student does not receive an e-mail, it means no seat is available for them in the wait-listed class.

Overloads of Courses

The standard course load for WPI students is one unit per term (exclusive of courses for ROTC and Wellness and Physical Education, which do not count towards overloads). Students may register in advance for a maximum of one unit in any term.

Registration for courses which will result in an overload may take place, on a space-available basis, after all current undergraduate students have had the opportunity to register for classes. This date will be posted on the Registrar's website.

Students are strongly encouraged to consult with their academic advisor before registering for an overload.

Overload charges will be computed each semester based on the course and project load based on the student's registration after the add/drop period in the second term of the semester.

Note: undergraduates taking graduate courses receive more credit for said courses and are billed accordingly. Please take this into account when considering overload fees.

Withdrawal from Courses

Students who wish to withdraw from a course or project will be assigned a grade of NR (No Record) by the instructor. The student should contact the instructor and indicate that they will not be continuing in the class.

Records and Audits

Transcript Fees

All official transcript requests must be made online and carry a fee per transcript.

Please visit https://www.wpi.edu/offices/registrar for more information.

Degree Audits

WPI programs Academic Progress Reports in Workday to track degree requirements. The degree evaluation is available in Workday.

Graduation

Each student must file an application for degree with the Registrar's Office in accordance with the following schedule:

To graduate in:

May – prior A-term
September – prior D-term
December – prior D-term

Independent Study

Independent Study provides the opportunity for an individual student or group of students, with the approval and under the direction of one or more faculty advisors, to study and to explore in greater depth an area of particular interest to the student and faculty member. An independent study may be used as a substitute for an existing WPI course, as an opportunity to study a topic not currently offered as a course at WPI, or to conduct directed undergraduate research.

Independent Study registration for terms A-E will be accepted up to the 10th day of the term (not including weekends) without penalty.

An independent study may be used to assign credit in a particular discipline only when at least one of the faculty advisors has an appointment in the department or program associated with the discipline or with the approval of the appropriate Department Head or Program Director. If disciplinary credit is not assigned to the independent study, the academic credit will be identified as Interdisciplinary (ID) and the credit will be assigned as free elective on the student's transcript.

Official Withdrawal or Leave of Absence

There are many reasons why a student may need or wish to take time away from WPI. There may be personal or medical issues interfering with their academics; opportunities for professional experience; family or community commitments; or the desire to just take a break.

- Institutional Leave of Absence (LOA): Request this if you are planning to return to WPI. Leaves may be granted for the remainder of the current semester (if applicable) and the immediately following semester (not counting summer). Leaves may be renewed for one additional semester, and an extension must be requested before the expiration date of the current leave. If a student does not return by the expiration date, they will be automatically withdrawn. For students with federal funding in their financial aid awards you will be reported to federal agencies as a federally withdrawn student. This may have impacts on deferment and loan repayment start times. Please contact the Office of Student Aid & Financial Literacy for further details.
- Official Withdrawal: Request this if you are leaving permanently and not planning to return to WPI.

Any reduction in charges is based on the student's certified last date of attendance.

Students who have attended through the 12th week of a semester (or the 5th week of B or D terms) may not withdraw or take an LOA for that semester and will be academically reviewed. They may withdraw or take an LOA for the following semester.

See Return from Leave of Absence section for information about returning to WPI after a leave. Students who officially withdraw are expected to apply through Undergraduate Admission if they decide they would like to return at a later date to pursue undergraduate study.

See full list below for more information and other types of withdrawals or leaves.

Restrictions to WPI access:

- You will be dropped from any classes and/or projects you have scheduled for future terms.
- You will not be able to live in university housing, and if applicable, will not be able to select or keep your future academic year assignment.
- You may not be able to retain your spot for an IQP/MQP Project Center.
- If you have financial aid, your financial aid will be readjusted.
- You will not be able to participate in campus activities, including clubs, sports, etc.
- Students on Institutional Leave of Absence will retain use of their WPI email. All other access will be removed.
- Students on Official Withdrawal will NOT retain use of their WPI email. All other access will also be removed.

Procedure:

1. Students should inform themselves about the consequences to the following if applicable
    1. Financial Aid
    2. Visa Status
    3. Housing
    4. Billing, including potential tuition adjustments
    5. Health insurance: If insured by student health insurance please check for coverage options.
    6. Undergraduate students schedule an appointment with Academic Advising
    7. And any other considerations.
2. Complete the appropriate form available at https://www.wpi.edu/offices/registrar
    1. Undergraduate Institutional Leave of Absence Form
    2. Undergraduate Official Withdrawal Form
3. If seeking a medical leave of absence, please make an appointment with the appropriate office below
    1. If seeking a medical leave of absence for psychological reasons, schedule an appointment with the Student Development and Counseling Center (SDCC).
    2. If seeking a medical leave of absence for all other medical reasons, schedule an appointment with WPI's Office of Health Services.
4. Submit completed form to Registrar's Office

Return from Leave of Absence

Students who have been away from WPI for a voluntary institutional leave of absence or medical leave of absence may request to return from leave of absence. The return from leave of absence process has been designed to make sure that students are ready to return successfully to WPI. Students must submit a request to return before the leave of absence expires. If the leave expires you will be automatically withdrawn.

All students requesting to return to WPI must complete the Request to Return from Leave of Absence Form and submit it to the Registrar's Office by the applicable deadlines. Please note that students returning from a medical LOA must be cleared by the appropriate office. Forms and information are available at https://www.wpi.edu/offices/registrar.

Deadlines:
Fall Semester: July 15th
Spring Semester: December 1st
Summer Session: May 1st

Part-Time Degree Students

Students may apply for Part-Time Student status on a **semester** basis at the Registrar's Office. Part-time students pay tuition on the basis of registered credit at the start of each semester, including credits for ROTC and PE. Campus housing will not be allowed. Part-time students may not engage in varsity/club sports, may not participate in any extracurricular activities, and are only eligible to apply for limited federal and state financial aid (institutional financial aid is not available) including any form of on-campus student employment. The following registration procedures apply:

- Students who wish to enroll as part-time students must apply by July 20 for the Fall semester and by November 15 for the Spring semester. Such status will allow a maximum of one unit per each semester of the academic year.
- Changing between full-time/part-time status is not allowed at mid-semester.
- Part-time students wishing to return as full-time students must be readmitted according to the procedures specified under Readmission in the Admissions section of this catalog

Non-Degree Students

Students wishing to take courses on a full-time or part-time basis as a non-degree student may do so by contacting the Registrar's Office. Non-degree students are permitted to earn a maximum of 18 credits (6/3rds) in a non-degree status. Non-degree students will be tracked through the Registrar's Office. Non-degree students pay tuition on the basis of registered credit at the start of each semester. Campus housing will not be allowed. Non-degree students may not engage in varsity/club sports, may not participate in any extracurricular activities, may be required to register for courses on a space-available basis, and *are not eligible for financial aid or any form of on-campus student employment*.

Summer Session (Term E)

With course offerings directed at meeting student needs, a variety of sessions, and both traditional and online classes, E-term provides flexibility for students looking to work over the summer and still take advantage of these academic opportunities. E-term is a great time to

- Speed up your time to degree completion
- Stay on track in the BS/MS program
- Lighten the load for the next year
- Get back into good academic standing

E-term offers an exceptional opportunity to participate in certain types of project activity on a convenient basis since classrooms and laboratories will be less crowded and outside field work will enjoy better weather conditions. E-term also offers an excellent opportunity to complete a qualifying project through a full-time effort during a single term.

Since class sizes are generally smaller in E-term, students will enjoy more individually-oriented course work – a real benefit for classes that students find challenging or courses that are designed to prepare students for more advanced classes in their major.

Students planning to participate in Term E should register at the regular spring registration period. For more information, including payment and financial aid information, visit the E-term webpage at: https://www.wpi.edu/academics/undergraduate/summer-courses/current-wpi-students

Students from other campuses are also invited to take advantage of E-term offerings at WPI. Admission to the summer session does not imply admission to regular academic year programs. Students desiring to continue their work at WPI following the summer session should seek admission following standard WPI admissions procedures issued through the Admissions Office.

Graduate Courses

WPI students may enroll in graduate courses as part of their regular undergraduate studies without being admitted to the graduate program. An exception: In order to enroll in graduate courses offered by The Business School, the student must have been admitted to a dual BS/MS program, regardless of department.

Effective in the fall 2011 semester, Undergraduate students taking graduate courses may use the conversion factor: 1 graduate credit = 1/6 undergraduate unit. The policy was put into place to recognize the additional academic challenge of graduate studies with an appropriate increase in academic credit. All credit increases will be manually processed through the Registrar's Office and may not be completed the same day of registration; therefore, your initial bill may not reflect the credit conversion.

Please note that this change might have an impact on students' planning, especially if enrolled in a BS/MS program. More importantly, it also can impact overload calculations. Here are some examples:

- If a student is registered for 5 undergrad courses and 1 grad course: the student has 5/3 plus 1/2 units (or 2 and 1/6 units total) => No overload
- If a student is registered for 3 undergrad courses and 3 grad courses: the student has 3/3 + 3/2 units (2 and 1/2 units total) => 1/6 unit overload

Please note that the standard course load for WPI students is one unit per term (exclusive of ROTC and Physical Education classes, which do not count toward overloads). Students who register for more than 7/3 (or 21 credits) per semester will be charged accordingly. Overload charges are computed at the beginning of B term and at the beginning of D term based on the course and project load included in the student's final term registration. Please note that project work is credit-bearing and is included in overload calculations.

Transfer Students

Transfer Agreements & Transfer Credit

WPI currently holds formal articulation agreements with specified programs of studies at Quinsigamond Community College. However, WPI will grant appropriate transfer credit from any accredited two-year or four-year institution.

WPI is able to offer a transfer credit evaluation once a transfer student is admitted. For incoming first year students, the transfer credit evaluation process is available after the enrollment deadline of May 1st, typically beginning in mid-May. Admitted transfer students and newly enrolled first year students should follow the WPI transfer credit guidelines, policy and procedure available at www.wpi.edu/+transfercredit, which included a list of transfer equivalencies to date. The Transfer Admissions team coordinates the process with WPI faculty who evaluate the coursework to determine credit eligibility. Each academic department at WPI reviews courses under their program, and provides a decision to the Transfer Admissions team. Admissions communicates any credit updates to the WPI Registrar's Office as well as WPI Academic Advising. In general, courses that are the academic equivalent of a WPI course with a grade of a B or better will be considered for transfer credit. College-level and lab-based chemistry and biology, calculus, calculus-based physics with lab, engineering science, and most social science and humanities and arts courses are typically considered for transfer credit. To be eligible for credit review, the courses must be completed on a college campus taught by college instructors. Early college, early entrance programs, or college coursework provided in partnership with a college or university but offered at the high school taught by high school teachers are not eligible for credit at WPI, with the exception of Project Lead The Way (PLTW). Online coursework is also typically not eligible. Additional courses that are not transferable include pre-calculus, non-calculus based physics or engineering science, and computer courses in BASIC.

Humanities & Arts Requirement for Transfer Students

As part of the WPI Plan, all WPI students must complete the Humanities and Arts Requirement. As such, all transfer students should review their humanities and arts coursework accepted for transfer credit at WPI and plan with the Humanities and Arts Department's coordinator for transfer students to determine next steps towards the completion of the HUA Requirement. All transfer students entering WPI with fewer than two units of humanities and arts credit must complete thematically related work in humanities and arts. This will include an inquiry seminar or practicum to the extent that the overall humanities and arts credit totals two units. The HUA Requirement is considered fulfilled for transfer students who have completed the equivalent of two units of humanities and arts work prior to their matriculation at WPI. A Completion of Degree Requirement form (or CDR) must be submitted once the HUA Requirement has been satisfied. This form can obtained at the WPI Registrar's Office, and will be completed by the Humanities and Arts Department coordinator for transfer students. For those transfer students who have satisfied the HUA Requirement based on work completed at their previous institution(s) and who submit the approved CDR form to the WPI Registrar's Office will have this information posted to their student account. This process normally takes place prior to or during the first term of full-time enrollment at WPI.

Special Programs

Special Programs for New Students

New Student Orientation

During the week prior to classes, the Student Activities Office and the Office of Academic Advising coordinate a comprehensive new student orientation program for all first-year and transfer students. New student orientation provides an introduction to the WPI experience, ranging from academic work and expectations and project-based education, to student life and campus activities. Led by upperclass student team leaders and Insight advisors, new students attend team meetings that are designed to familiarize them with the overall campus environment.

Insight Program

Beginning with New Student Orientation and continuing through the first semester, incoming first year and transfer students are assigned to an Insight Team, a group of students and advisors dedicated to assisting with the transition to college. This group of fellow students and mentors will help new students acclimate both personally and academically, and make the most out of their first year at WPI.

Connections Pre-Orientation

The **Connections Pre-Orientation** is a week-long residential bridge program at Worcester Polytechnic Institute (WPI) held in August prior to New Student Orientation (NSO) and the Insight Program. Connections helps entering eligible new and first-year students make a smooth transition from high school to college.

The **Connections Academic Immersion Experience** allows new students to have a jump start and introduction to the WPI course structure (in a low stakes environment), an opportunity to meet WPI faculty, and form relationships with peers while learning college study skills and helpful methods for navigating through WPI. Participants who choose to take a summer course in E-Term will also have the opportunity to attend workshops in the Fall semester (A-Term and B-Term) which build upon the experiences and skillsets students bring to WPI and cover additional topics such as faculty and staff mentoring, major exploration, and guidance on course selection. This will be a time to reconnect with your Connections peers and a place to ask those questions you might have.

The Connections Pre-Orientation Program is offered at no cost to pre-registered eligible first-year WPI students. See the website for more information.

Great Problems Seminars

This is a two course sequence designed to serve as an introduction to project work and university level research with a focus on themes of global importance. Each seminar has at its core an important problem. Students explore the complexity of our global issues, and demonstrate their ability to solve some aspect of the big problem. The skills the students develop are exactly what they need to be successful both in project work at WPI and in their future careers.

Examples: In Food Sustainability, students and faculty focus on issues surrounding food: nutrition, production, economics, and policy issues. Student projects have included plans for urban gardens, extending Meals on Wheels to younger but non-mobile seniors and nutritional information in the dining hall.

In Power the World, the production, distribution and use of all forms of energy and associated ethical issues are reviewed. Student projects have included stove design for indigenous people, improvements on solar-powered emergency medical devices and energy audits of campus buildings.

Themes will change from year to year. Enrollment is limited.

Discovering Majors and Careers

Discovering Majors and Careers is a class for first year students undecided about academic majors. This 1/12 unit course can be taken on top of a regular course load. Students enrolled in this course will utilize a variety of tools including self-assessments, panels, campus resources, and informational interviews with alumni to help identify personal interests, WPI majors, related careers, and life goals.

Additional Resources on the Web

The Undergraduate Programs Web Site (www.wpi.edu/Academics/Undergraduate/)

The Academic Advising Office (www.wpi.edu/+OAA)

The First Year Web Site (www.wpi.edu/+FYE)

Cooperative Education

Cooperative Education - Undergraduate

Co-op

The WPI Cooperative Education Program (Co-op) is an opportunity for undergraduate students to alternate time in the classroom with extended periods of paid, full-time, career-related work experience in industry or government. This optional program can be done during the following scenarios:

1. Summer plus A term
2. Summer, A term and B term
3. C term, D term and Summer

4. D term and Summer
5. Summer, A term, B term, C term and D term
6. A term, B term, C term, D term and summer

Most students elect to participate in one Co-op assignment, though up to two is possible. Because Co-op is not a credit-baring program, it is recommended that students pre-plan during their first or second year. Preparation of a complete four year plan with the student's academic advisor is required to ensure compatible scheduling of work periods and academic courses.

In order to qualify for the Co-op program, students must meet the following requirements:

1. Must be a current, full time, undergraduate WPI student in good standing. Note: If any of the following conditions apply a student may petition for eligibility.
    1. Not in good academic standing (i.e. on academic warning or probation)
    2. Have financial holds on their account
    3. Have a judicial record. Note: having a judicial record does not automatically preclude you from participating in a Co-op.
    4. Want to register for up to 1/3 unit of course while on Co-op.
2. International students must complete one full academic year at WPI before being eligible for Co-op, due to US Federal Government regulations. In addition, the Co-op must be related to the major (not minor). For questions, please contact International House.
3. Understand the impact Co-op would have on your federal and institutional financial aid through a meeting with the Office of Student Aid & Financial Literacy.
4. Understand the impact your Co-op will have on your course schedule and outline your four year plan, including projects, Co-op, etc. and have it reviewed through a required meeting with your Faculty Advisor.
5. Approval will be needed from your Faculty Advisor, Office of Student Aid & Financial Literacy, Supervisor at your Co-op, Bursar, Dean of Students Office, Career Development Center (CDC), and International House (if applicable). Approvals are done electronically through Handshake, beginning with you entering your Co-op information in your Handshake Account's Experiences section. The deadline for fall Co-op application is August 1; the deadline for spring Co-op application is December 1. Co-op applications received after deadline are reviewed on a case by case basis. Submissions after the add/ drop deadline will not be approved.
6. To be considered, the Co-op must be full time (at least 30 hours per week), paid, 4-8 months in duration and related to your major and career goals.
7. Understands and accepts the Terms of Agreement. (see website for more information)

Advantages for Students

Co-op offers several advantages for students:

1. Gain experience, build their resume and bring theory into practice.
2. Earnings enable students to pay a significant portion of their college expenses.
3. Sharpen skills and abilities as an emerging professional.
4. Test out career options to help clarify career goals and interests.
5. Return to school with new knowledge and experience in their field.
6. Position themselves for future opportunities; Co-op participants are preferred full time hires.
7. Transcript will show Co-op and indicate company name.

Information and Registration

Students interested in exploring the possibility of participating in the co-op program should attend drop-ins or schedule an appointment with a CDC Career Advisor.

HECCMA Course Cross-Registration

The Higher Education Consortium of Central Massachusetts (HECCMA) consists of the following institutions: Anna Maria College, Assumption College, Clark University, College of the Holy Cross, Cummings School of Veterinary Medicine at Tufts University, Massachusetts College of Pharmacy and Health Sciences, Nichols

College, Quinsigamond Community College, University of Massachusetts Medical School, WPI and Worcester State University. Full-time WPI students who cross-register for courses at other HECCMA colleges pay no extra fees. Students are limited to one course per semester. The no-charge plan does not include evening colleges or summer school. For cross registration information visit https://www.heccma.org/students/.

Students interested in registering for HECCMA courses should discuss their program with their advisors, and then obtain regulations and registration forms from the Registrar's Office.

Societies, Registration and Licensing

Engineering Societies

All engineers are professionals in accordance with the definition of engineering, one of which states that "engineering is the profession in which a knowledge of the mathematical and natural sciences gained by study, experience and practice is applied with judgment to develop ways to utilize, economically, the materials and forces of nature for the benefit of mankind." Professional engineers also observe a code of ethics, exercise judgment and discretion while providing their services, and are involved in a confidential relationship with their clients. Professional engineers enjoy legal status, use professional titles, and associate together through professional societies.

An excellent way to begin learning about the status of the professional engineer is to join the student branch of a professional society relevant to your interests. At WPI, students are encouraged to join the student branches of such societies as the American Academy of Environmental Engineers and Scientists (AAEES), American Society for Metals (ASM), American Society of Mechanical Engineers (ASME), the Institute of Electrical and Electronic Engineers (IEEE), the American Society of Civil Engineers (ASCE), the American Institute of Chemical Engineers (AIChE), the American Institute of Aeronautics and Astronautics (AIAA), the Association of Computing Machinery (ACM), the American Nuclear Society (ANS), APICS, the Institute of Industrial Engineers (IIE), the National Society of Black Engineers (NSBE), the Society of Automotive Engineers (SAE), the Society of Manufacturing Engineers (SME), the Society of Fire Protection Engineers (SFPE), the Society of Women Engineers (SWE), the American Chemical Society, (ACS), the Society of Hispanic Professional Engineers (SHPE), and Women in CyberSecurity (WICyS). For information on these organizations, see the appropriate department head.

Engineering Registration and Licensing

In order to become a "Professional Engineer" (P.E.) and enjoy the legal status which affords certain rights, privileges and responsibilities, engineers must qualify through the formal procedures of registration and licensing. Procedures vary from state to state, but in most cases, the applicant must first pass a Fundamentals of Engineering Examination.

Fundamentals of Engineering Examination

To become legally registered as a professional engineer (P.E.), candidates must submit data regarding formal education and technical ability to the appropriate state Board of Registration for Professional Engineers. Two major examinations, The Fundamentals of Engineering Examination (also called Engineering-in-Training, E.I.T.) and the Professional Practice Examination (P.P.E.), must be successfully completed as a measure of technical ability. The Fundamentals Examination must be taken first; the Professional Practice Examination must then be taken after a designated period of substantial professional experience, usually a minimum of four years. The Fundamentals Examination and Professional Practice Exams are administered year-round.

There are several possible qualification paths to registration as a P.E. The quickest and most common route is to obtain a degree from an ABET (Accreditation Board for Engineering and Technology-formerly ECPD) accredited curriculum, and to acquire the specified amount of suitable professional level experience in addition to passing the two examinations mentioned above. There are seven ABET accredited curricula at WPI-biomedical engineering, civil engineering, chemical engineering, electrical and computer engineering, environmental engineering, industrial engineering, manufacturing engineering, and mechanical engineering. Persons with an unaccredited degree can still become registered in most, but not all, states by submitting evidence of a longer "apprenticeship" period (variable by states) before taking the two examinations. Students should strive, if at all possible, to pursue a program which is accredited by ABET and should work closely with their advisors and appropriate major departments to assure that the total program qualifies for accreditation, since this will greatly facilitate the achievement of registration in the future.

ALL SENIOR ENGINEERING MAJORS IN BME, CE, CHE, ECE, AND ME ARE URGED TO TAKE THE FUNDAMENTALS OF ENGINEERING EXAMINATION WHICH IS GIVEN ON CAMPUS EACH FALL AND SPRING. There will never be a better time!

Refresher courses for students, alumni and practicing engineers are available. Successful completion of this examination is normally the first step in eventually obtaining the right to use the initials "P.E."

WPI's Office of Continuing Education sponsors an eleven session EIT Refresher course from mid-January through mid-April on the WPI Campus. The course, which is taught by WPI faculty, includes reviews of the major topics covered on the exam. For further information, call 508-831-5517.

Description of Fundamentals of Engineering Examination (F.E.E.)

Typical Date Given: Last Saturday in October (also in April).
***Typical Application Deadline*:** First week in September (also in January).
***Duration*:** Eight hours.
***Type*:** Multiple choice, open book.

Student Exchanges

As technology and commerce become increasingly international in outlook, students in engineering, science and business must learn about countries and cultures other than their own. To respond to this need, WPI offers its students an extensive range of opportunities to broaden their academic and cultural perspectives through participation in the Global Projects Program. WPI also offers traditional exchange programs.

The principal academic emphasis in all exchanges is upon course work. In such programs, students must work closely with their advisor, the academic advisor of the exchange program, and the program coordinator at the site to design an individual program of study. Students have the responsibility of obtaining prior tentative approval from their department that courses taken abroad will count towards departmental distribution requirements. For final transfer credit evaluation, students must provide upon return the necessary detailed information on the content of courses taken abroad and the satisfactory completion of all work. In some exchanges, opportunities exist to complete project work (IQP, MQP, and Humanities and Arts requirement). The exchanges offer exceptional possibilities for projects comparing American and overseas applications of technology and the impact of technology on society. For WPI students on these exchanges, time is usually available for additional travel, before or after the formal academic period.

For more information on these programs, consult with the Global Experience Office in the Project Center or the academic advisor listed for each program.

Language Requirements

The usual language of instruction at most of the exchange institutions is the official language of the host country. While these institutions may offer a few courses taught in English, most lectures will be given in a foreign language. Thus, exchange students who intend to complete substantial course work must acquire the necessary language background. In some cases intensive language instruction can be arranged on site. In other cases, students acquire the language background through courses taught at WPI or other colleges, or by self-study. A few exceptions exist at some technical universities where the official language of instruction may be English.

University of Applied Sciences; Konstanz, Germany; Exchange

Students who already know German or are planning to begin studying it have the opportunity to study in Germany for a semester at the Hochschule für Technik, Wirtschaft und Gestaltung (HTWG: university of applied sciences; http://www.htwg-konstanz.de/) in Konstanz, Germany. The city of Konstanz, located at the western end of Lake Constance (in German, der Bodensee) and right on the border with Switzerland, is one of Germany's most beautiful cities, with a well- preserved medieval and renaissance city center. The snow- covered Alps are visible across the lake and the HTWG campus is on the bank of the Rhine where it flows out of the lake and heads north. The city is pedestrian friendly, has great food, and there are unlimited opportunities for biking, boating, swimming, skiing, and hiking in the immediate vicinity. Weekend travel to Austria, Italy, and France is easy and Switzerland is literally right across the street. Students who begin their study of German in Terms A, B, C can complete the Humanities and Arts requirement by attending the HTWG in Terms D and E. WPI will not charge these students extra tuition for Term E. Students whose German is already at an intermediate or advanced level may take either advanced language courses or technical courses at the HTWG. Admission to this exchange program is competitive.

NEOMA Business School, Rouen, France; Exchange

Perfect opportunity for any Business School major or minor to spend a fall or spring semester in France, immersing yourself in French culture while studying at NEOMA Business School. NEOMA is one of the top ten business schools in France and ranked as one of the best business schools in Europe by the Financial Times. Courses at NEOMA are taught in English and French.

Students may study in Rouen, France. Rouen is located on the River Seine with a beautiful medieval city center. Rouen was fashioned by history, and has seen the likes of Joan of Arc, William the Conqueror and Claude Monet walk its streets. Dynamic festivals and events bring present day Rouen to life. The campus in Rouen offers students beautiful surroundings in seven hectares of woodland and is equipped with state-of-the-art equipment. It is located less than two hours from Paris and the coast of Normandy.

Students participating in this exchange program pay regular WPI tuition, but pay semester room and board to NEOMA. WBS staff will help students map out a curriculum at NEOMA, ensuring all NEOMA credits will transfer back into WPI. Admission to this exchange program is competitive.

Combined Bachelor/Master’s Program

Introduction

WPI undergraduates can begin work on a graduate degree by enrolling in a combined Bachelor’s/Master’s program. This accelerated course of study allows students to obtain an MS degree after only five years of full-time work (i.e., typically one year after completion of the BS). Students often obtain the BS and MS in the same field or department, but with careful planning some students complete the combined BS/MS program in two different fields; the combination of a BS in Civil Engineering and an MS in Fire Protection Engineering is a common example. (Throughout this section, “MS” will be used to refer to all Master’s-level degrees; most students who complete the combined program obtain the MS).

Planning your Program

Because BS/MS students use some approved courses to satisfy the requirements of both degrees simultaneously, it is crucial for them to plan their curriculum early in their undergraduate career.

The specific course and MQP requirements for a BS/MS program are determined individually, so students should consult with their own advisor as well as the graduate coordinator in the department in which they plan to pursue their MS degree early in their Junior year. This consultation, or series of consultations, should produce a slate of approved undergraduate courses that will be used for graduate credit. Sometimes the instructors of these courses will ask BS/MS students to complete additional work, or will otherwise hold them to higher standards of achievement.

A student’s advisor and graduate coordinator will also determine what role the MQP will play in the BS/MS program. Sometimes the MQP provides a foundation for a thesis. In cases where the BS and MS are not awarded in the same field, the MQP usually relates to the graduate program’s discipline.

Once the specific course and MQP requirements have been established, students complete a Course Selection Form which is submitted to the relevant department(s) for approval. This written agreement constitutes the set of conditions that must be met for a student to complete the BS/MS program. They are a plan for completing the requirements for both degrees and they will not supersede or otherwise obviate departmental and university-wide requirements for either degree. The completed, signed form must be submitted to the Registrar before the student may matriculate in the combined program.

How to Apply

Students almost always apply for admission to the BS/MS program in their Junior year, typically after they have established their curriculum and other program requirements and completed the Course Selection Form with their faculty advisors. Applications are submitted to the Office of Graduate Admissions and are processed with all other graduate applications. Once a decision has been reached, the Office of Graduate Admissions will notify the student, usually within six weeks of completing the application.

Program Requirements

Only registered WPI undergraduates may apply for admission to the combined BS/MS programs. Students are considered undergraduates, no matter what courses they have completed, until they have met all of the requirements for the Bachelor's degree. In order to receive the BS and the MS, all of the requirements for both degrees must be completed.

In most departments a student may take up to four years to complete the Master's portion of the BS/MS program. There are exceptions, however, so students are advised to discuss their timetable with the appropriate advisor or graduate coordinator. Students who stop registering for classes for an extended length of time may be asked to petition the Committee for Graduate Studies and Research to continue their program.

Credit Equivalence and Distribution

No more than 40% of the credit hours required for the Master's degree, and which otherwise meet the requirements for each degree, may be used to satisfy the requirements for both degrees. In some departments, students may not double-count more than 30% of their graduate credits. Consult the graduate catalog for the requirements of your program.

Effective in the fall 2011 semester, Undergraduate students taking graduate courses may use the conversion factor: 1 graduate credit = 1/6 undergraduate unit. The policy was put into place to recognize the additional academic challenge of graduate studies with an appropriate increase in academic credit. All credit increases will be manually processed through the Registrar's Office and may not be completed the same day of registration; therefore, your initial bill may not reflect the credit conversion.

Please note that this change might have an impact on students' planning, especially if enrolled in a BS/MS program. More importantly, it also can impact overload calculations. Here are some examples:

- If a student is registered for 5 undergrad courses and 1 grad course: the student has 5/3 plus 1/2 units (or 2 and 1/6 units total) => No overload
- If a student is registered for 3 undergrad courses and 3 grad courses: the student has 3/3 + 3/2 units (2 and 1/2 units total) => 1/6 unit overload

Please note that the standard course load for WPI students is one unit per term (exclusive of ROTC and Physical Education classes, which do not count toward overloads). Students who register for more than 7/3 (or 21 credits) per semester will be charged accordingly. Overload charges are computed at the beginning of B term and at the beginning of D term based on the course and project load included in the student's final term registration. Please note that project work is credit-bearing and is included in overload calculations.

Campus Resources

Academic Advising

WPI's advising program is based on a cooperative and understanding relationship between students and advisors. Under the WPI Plan, students have the final responsibility for designing their own educational experience at WPI which includes understanding all their degree requirements and making sure those requirements have been satisfied for graduation. Advisors will support students in doing so.

All WPI students are assigned an academic support advisor in the Office of Academic Advising upon matriculating to WPI. These advisors are not major specific and will work with the student throughout their time at WPI to provide holistic and individualized academic support. In the second semester of the first year, students are also assigned a Faculty Advisor who is a professor in the student's chosen major. The two advisors work in tandem to support students in their academic pursuits and pathway to graduation.

The role of both the academic support advisor and the faculty advisor is to help their advisees design a program of study which reflects the students' interests and professional goals. While advisors are willing to suggest specific programs of study and help students explore the academic opportunities WPI has to offer, they will not insist that students follow a particular path. Advisors also help students choose among academic alternatives, help interpret degree requirements and review their Academic Progress Reports. Students are expected to understand curriculum planning resources such as the Program Tracking Sheets and Academic Progress Reports and their implications for academic progress. Therefore, it is critical that students take the initiative to consult regularly with their academic advisors for help with curriculum planning and course selection.

The Office of Academic Advising at WPI has several areas of focus, including but not limited to: 1) general academic advising; 2) academic resources; 3) transition programs; 4) Pre-Health programs; 5) nationally competitive scholarships and fellowships advising;

General Academic Advising

Students can come to the Office of Academic Advising for general advising in areas such as course selection, academic standing concerns, major selection, and individualized academic coaching. Support is also offered for students looking to include a co-op experience or pursue a BS/MS program. Academic support advisors are available to meet with students throughout the year for any of the reasons above, and may provide drop-in support at various times of the academic year such as add/drop periods and course registration. Academic support advisors may refer students to their Faculty Advisor when appropriate. Students are encouraged to meet with their Faculty Advisor for major-specific support.

The academic coaching program, primarily geared toward students on Academic Warning and Probation or who are at risk of being on Warning or Probation, includes guidance from an Academic Advisor in areas such as learning styles, effective study strategies, problem solving and critical thinking skills, organization, and time management. Students work on setting academic goals and designing learning and study strategies that work best for them.

Academic Resources Center

The Academic Resources Center (ARC) is located on the 5th floor of Unity Hall and houses the academic tutoring program and MASH (Math and Science Help). Peer tutors and MASH leaders are students who have demonstrated a mastery of material, and have been trained in peer tutoring and communication.

MASH is an academic support program for students enrolled in math and science classes. Offered to all students in a supported course, MASH provides assistance through regularly scheduled weekly study sessions beginning the first week of every term.

MASH review sessions are offered for a limited number of courses which students and faculty have identified as challenging. Many of the courses are typical first year classes, allowing extra support for students transitioning to college-level work. Each session is guided by a MASH leader, an undergraduate student who has taken the course before and has excelled. They understand the course material and what the instructor expects.

Through the MASH and tutoring programs, students become actively involved with the content material in a supportive environment. Studies show that students who attend MASH or tutoring regularly earn higher grades than students electing not to participate. Even more importantly, they learn how to master new concepts, learn how to put ideas into perspective, develop a better way to study, and effectively manage their time.

Transition Programs

The Office of Academic Advising oversees programming for First Year students (including the Insight Program) and sophomore students. OAA also provides specific programs and advising opportunities tailored to the unique needs of students transferring to WPI from other institutions.

Insight Program: Beginning with New Student Orientation and continuing through the first semester, incoming first year and transfer students are assigned to an Insight Team, a group of students and advisors dedicated to assisting with the transition to college. This group of fellow students and mentors will help new students acclimate both personally and academically, and make the most out of their first year at WPI.

Pre-Health Advising

The Pre-Health Advisor works with students who are interested in pursuing careers in the health professions.

Students may meet with the Pre-Health Advisor to
a) explore various careers in healthcare and receive assistance in selecting the most suitable path for themselves;
b) receive advice regarding pre-requisite courses and other preparation for various health professions programs (e.g. medicine, dentistry, veterinary medicine, optometry,
physician assistant studies, physical therapy among others;
c) receive assistance throughout the professional school application process, including the arrangement of a committee recommendation letter;
d) take advantage of academic coaching or receive general help.

Special programming is offered throughout the year for Pre-Health students. To get connected with the Pre-health Advisor, students may email academic-advising@wpi.edu.

Scholarships and Fellowships Advising

Nationally competitive scholarships and fellowships are selective awards that provide financial and professional support for individuals who exhibit interest in a particular area or field of study and who are likely to make positive contributions and advancements in their field.

These awards are available to help fund undergraduate education, graduate school, international study, and many provide additional benefits including access to alumni networks, employment opportunities, and conference funding. Funding from each scholarship is provided for a specified amount of time such as an academic year or for several years.

The Office of Academic Advising provides students with support and guidance with the application process for these highly competitive awards. This includes assistance in understanding the nomination process, feedback on application materials, support in determining suitable letter writers, and submission of the final application to the scholarship foundation for selected nominees.

Many national scholarships and fellowships require official nomination from WPI, which entails an on-campus selection process. Students who are interested in being considered for institutional nomination for a scholarship opportunity can connect with the Office of Academic Advising for additional information regarding nomination procedures. For more information click here.

Academic Resources

Academic Resources Center

WPI's Academic Resources Center (ARC), located in Unity Hall, provides academic support services that are designed to enrich and enhance the learning experience of all WPI undergraduate students. Its student-based collaborative learning environment offers individualized assistance in a variety of subjects, as well as a comprehensive peer tutoring program. The ARC offers individual and group tutoring (MASH) sessions. All peer tutors and MASH Leaders are certified by the College Reading and Learning Association, and help students in a variety of academic subjects. Peer tutors are available by appointment, whereas MASH sessions are drop-in. To schedule an appointment with a peer tutor visit tutortrac.wpi.edu.

The Writing Center

The WRITING CENTER, located on the second floor of Salisbury Labs (SL 233), employs ~20 peer writing tutors trained to help undergraduate and graduate students with any type of communication project: course papers and project reports, application documents, dissertations, oral presentations and slides, website and document design, and more. Through one-on-one appointments, tutors talk through project goals, help writers brainstorm and organize ideas, provide a critical reader's feedback, and provide mini-reviews of grammar and punctuation rules. To make an appointment, visit our website at www.wpi.edu/+writing. Faculty interested in designated tutoring for courses should contact Writing Center Director, Ryan Madan, at x6561 or ryanmadan@wpi.edu

Writing Courses and Advisors

For information on WPI's writing programs, see Humanities and Arts faculty as follows:

Students interested in the Professional Writing major or the Writing and Rhetoric minor should contact Sarah Riddick (sriddick@wpi.edu) about these programs.

The HUA advisors for undergraduate international students whose native language is not English are Esther Boucher-Yip and Althea Danielski. For more information you may contact Esther Boucher-Yip at efboucher@wpi.edu and Althea Danielski at amdanielski@wpi.edu.

Career Development Center

The Career Development Center (CDC) at WPI serves all degree seeking undergraduate and graduate students in the development of life-long skills related to careers, the internship/co-op and job search process, and the pursuit of graduate studies. The CDC serves all undergraduate and graduate students in addition to offering free lifetime alumni services.

The Career Development Center (CDC) provides a variety of services to students including the following:

1. **INDIVIDUAL APPOINTMENTS** – Students can easily schedule one-on-one appointments with a CDC Staff Member online through their Handshake account in order to get help on a wide variety of topics. Students can choose to discuss topics ranging from major selection, exploring career options, searching for internships/co-ops/jobs, interviewing, applying to graduate school, and evaluating and negotiating job offers.
2. **DROP-IN HOURS** – Students can also be seen by a CDC Staff Member during advertised drop-in hours. During these times, an appointment is not required and students can get help on a first-come, first-served basis with their resume/cv, cover letter, interviewing skills, job offer evaluation and negotiation, and other quick 15 minute questions.
3. **HANDSHAKE** – All students are provided with an account for the CDC's web-based system called Handshake. Handshake contains internship, co-op, part-time, and full-time job opportunities posted by employers for WPI students. Handshake also contains a company directory and information about upcoming events and career fairs hosted by the CDC. In addition, Handshake's resources section has special subscription resources (free of charge) that the CDC provides for students.
4. **SUBSCRIPTION RESOURCES** – The CDC maintains a subscription to several resources to assist students in their career development and job search process, which are housed in Handshake. Among the many resources the CDC offers to students are: MyPlan (self-assessments, majors and careers database, graduate school search), CareerShift (internship/job, company, and contacts search), GoingGlobal (country/state-specific career resources and H-1B visa company database, interviewstream (interview practice and feedback), Vault (Career, Industry and company exploration) and Versatile PhD (Industry career options for PhDs). These are free for students to use.

5. **CAREER OUTLOOK PAGES –** The CDC has put together a webpage with short descriptions of what can be expected from different WPI majors and careers, including average salaries, companies that have hired WPI graduates in a particular field, sample job titles, professional associations and clubs, popular industries, and more.
6. **CAREER FAIRS –** Each year the CDC organizes career fairs for students to network with employers and obtain information on full-time, summer internship and co-op opportunities. The CDC hosts 2 in person events and many more events virtually.
7. **CAREER WORKSHOPS** – Throughout the year, the CDC delivers frequent workshops for students on a wide variety of career development topics. Common workshop topics include: resumes/cover letters, internship/co-op/job search strategies, networking, interview skills, job offers and negotiation, and applying to graduate school, among others.
8. **NETWORKING NIGHTS and CAREER EXPOS** – The CDC hosts networking nights and career expos throughout the year to give students an opportunity to network with alumni, fellow students, and industry professionals.
9. **COMPANY INFORMATION SESSIONS –** Companies host events on-campus to present on their organization, culture, and technology while networking and sharing opportunities with students. Check your WPI Handshake account for upcoming events.
10. **JOB OPPORTUNITIES** – Job Postings are presented to WPI students and alumni exclusively by employers who want to hire WPI talent within the CDC Handshake system. Review and apply to Cooperative Education, Internships and Job positions to develop work experience.
11. **ON-CAMPUS INTERVIEWS –** Each year over 1,000 interviews are held on campus with a variety of private, non-profit, and government organizations. Employers interview students for full-time, summer internship, and co-op opportunities. For a list of companies actively seeking candidates for interviews, please utilize your Handshake account
12. **RESUME DATABASE** – Students and recent alumni may elect to make their resume viewable to employers through Handshake. If available, employers can access your "public" resume and may result in an interview request leading to a future opportunity.
13. **GRADUATE STUDIES –** The Career Development Center (CDC) and the graduate coordinators in each department can help students search for graduate programs at WPI (BS/MS, MS, MEng, PhD) or elsewhere and assist with preparing for and applying to graduate school.
14. **ALUMNI ASSISTANCE** – WPI alumni have free lifetime access to the CDC's services, whether they are seeking new employment or making a career change.

Location

The Career Development Center is located in the lower level of the Project Center. The CDC can be contacted by phone at 508-831-5260 or by email at cdc@wpi.edu. The website is www.wpi.edu/+CDC

Center for Well-Being

WPI's Center for Well-Being (CWB) is a hub for cross-functional campus efforts aimed at improving student, community, and campus well-being through evidence-based practices, coordinated initiatives, the support of student and faculty research, and strategic visioning.

The CWB takes a holistic approach to well-being that empowers individuals to foster a sense of vitality (managing cognitive, physical, emotional, social, and spiritual energy), meaning and purpose, enjoyment, connection, and community. The CWB also utilizes comprehensive and coordinated initiatives that encompass peer advocacy, academic initiatives, population-based interventions, individual and small group training, and culture change.

The Center for Well-Being provides a number of services to students, faculty, and staff, including:

- **A Supportive and Safe Space**: The Center offers a beautiful and supportive oasis of calm and peace to gather, relax, reflect, and recharge. All are welcome to enjoy community spaces for popping in for a wellness break and cup of tea or be soothed by the water wall while doing puzzles.
- **Hub for Wellness Resources**: Not sure what well-being resources are available at WPI, or what support you need? The staff of the CWB can help connect you to the well-being support and resources you need.
- **Quiet Spaces for Meditation or Reflection**: Sign up or drop in for a 15-minute Sip of Wellness session in the Rest and Recovery Room or schedule a Reiki session with our certified Reiki master.

- **Gathering Spaces for Group Programming:** The Center for Well-Being Programming Room and conference rooms can be requested for hosting your wellness event by emailing cwb@wpi.edu.
- **Coordination of Wellness Days**: The CWB works with departments and student groups to coordinate programming on Wellness Days. If you are interested in sponsoring or co-sponsoring an activity or event, please fill out the Wellness Day Event Request Form on our website or email cwb@wpi.edu.
- **Wellness Programs**: CWB programs are offered in a variety of formats and settings so that individuals and groups can create their own well-being journey. Some programs are offered as drop-in group sessions while others require pre-registration. Interested in a wellness session for your club, organization, or department? Email the CWB at cwb@wpi.edu!
- **Peer Advocacy and Support:** The Center for Well-Being Peer Well-Being Ambassadors are trained to provide learning and wellness coaching and mentoring. They can also help you figure out what wellness support you need and where to find it.
- **Individual Consultations**: Looking for more personalized support to foster your wellness and resiliency? Email the CWB at cwb@wpi.edu to request an appointment with our Director, Associate Director, or Peer Well-Being Ambassadors.
- **Mental Health Awareness Education and Suicide Prevention Initiatives**: The CWB works with the Student Development and Counseling Center to ensure everyone is able to recognize signs of distress and know what to say if a friend or colleague needs help. Programming includes Kognito, an online suicide prevention simulation, as well as more intensive learning through Recognizing and Responding to Student Distress (RRSD), Question, Persuade, Refer (QPR), and Student Support Network (SSN). Visit the CWB website for more information.
- **Research and Project Opportunities:** The Center for Well-Being supports academic and research initiatives focused on studying and promoting health and well-being through research projects, IQPs, MQPs, or graduate projects.
- **Wellness Courses for WPE Credit:** In collaboration with Physical Education, Recreation, and Athletics (PERA), the Center for Well-Being offers wellness courses as an option for completing the Wellness and Physical Education (WPE) requirement. Wellness courses are numbered WPE 1600 to 1999 for students to easily identify the wellness courses that fulfill the WPE requirement.

Location

The Center for Well-Being is located in Daniels Hall, Room 102, in the Morgan/Daniels Wedge. The CWB can be contacted by phone at 508-831-6494 or by email at cwb@wpi.edu. The website is https://www.wpi.edu/offices/center-well-being.

Cooperative Education

Cooperative Education - Undergraduate

Co-op

The WPI Cooperative Education Program (Co-op) is an opportunity for undergraduate students to alternate time in the classroom with extended periods of paid, full-time, career-related work experience in industry or government. This optional program can be done during the following scenarios:

1. Summer plus A term
2. Summer, A term and B term
3. C term, D term and Summer
4. D term and Summer
5. Summer, A term, B term, C term and D term
6. A term, B term, C term, D term and summer

Most students elect to participate in one Co-op assignment, though up to two is possible. Because Co-op is not a credit-baring program, it is recommended that students pre-plan during their first or second year. Preparation of a complete four year plan with the student's academic advisor is required to ensure compatible scheduling of work periods and academic courses.

In order to qualify for the Co-op program, students must meet the following requirements:

1. Must be a current, full time, undergraduate WPI student in good standing. Note: If any of the following conditions apply a student may petition for eligibility.
    1. Not in good academic standing (i.e. on academic warning or probation)
    2. Have financial holds on their account
    3. Have a judicial record. Note: having a judicial record does not automatically preclude you from participating in a Co-op.
    4. Want to register for up to 1/3 unit of course while on Co-op.
2. International students must complete one full academic year at WPI before being eligible for Co-op, due to US Federal Government regulations. In addition, the Co-op must be related to the major (not minor). For questions, please contact International House.
3. Understand the impact Co-op would have on your federal and institutional financial aid through a meeting with the Office of Student Aid & Financial Literacy.
4. Understand the impact your Co-op will have on your course schedule and outline your four year plan, including projects, Co-op, etc. and have it reviewed through a required meeting with your Faculty Advisor.
5. Approval will be needed from your Faculty Advisor, Office of Student Aid & Financial Literacy, Supervisor at your Co-op, Bursar, Dean of Students Office, Career Development Center (CDC), and International House (if applicable). Approvals are done electronically through Handshake, beginning with you entering your Co-op information in your Handshake Account's Experiences section. The deadline for fall Co-op application is August 1; the deadline for spring Co-op application is December 1. Co-op applications received after deadline are reviewed on a case by case basis. Submissions after the add/ drop deadline will not be approved.
6. To be considered, the Co-op must be full time (at least 30 hours per week), paid, 4-8 months in duration and related to your major and career goals.
7. Understands and accepts the Terms of Agreement. (see website for more information)

Advantages for Students

Co-op offers several advantages for students:

1. Gain experience, build their resume and bring theory into practice.
2. Earnings enable students to pay a significant portion of their college expenses.
3. Sharpen skills and abilities as an emerging professional.
4. Test out career options to help clarify career goals and interests.
5. Return to school with new knowledge and experience in their field.
6. Position themselves for future opportunities; Co-op participants are preferred full time hires.
7. Transcript will show Co-op and indicate company name.

Information and Registration

Students interested in exploring the possibility of participating in the co-op program should attend drop-ins or schedule an appointment with a CDC Career Advisor.

George C. Gordon Library

The George C. Gordon Library welcomes 300,000 visitors each year, and provides resources and innovative services that support teaching, learning, scholarship, and community at WPI. Gordon Library Information Services, the ITS Service Desk, and the Technology for Teaching and Learning (TTL) group of the Academic Technology Center (ATC) are conveniently co-located near the library's main entrance on the second floor. The adjacent Class of 1970 Library Café offers food and beverages. During the academic year, students may access the library from 8am to 1am Monday-Thursday, until 9pm on Friday and Saturday, and until 1am on Sunday.

The library's four floors offer a wide variety of individual and group study spaces, including modern private carrels and team study areas on the upper level, and a floor dedicated to quiet study (1st floor/lower level). The library's eleven Tech Suites are private reservable collaborative rooms, seating up to six people and equipped with large monitors and wireless screen-sharing technology. Additional group study spaces and several individual study or interview rooms are located throughout the building.

The library offers both wireless and wired computer network access throughout the library's open study areas, with over 50 computers that offer free access to dozens of high quality software packages. The Multimedia Lab on the first floor offers specialized multimedia software and hardware.The library offers several tools to support accessibility and convenience on the second floor, including printers, a KIC book scanner, and an accessibility station that includes Kurzweil 3000 text-to-speech software.

The staff of Gordon Library provides many services to support student learning. Our research and instruction librarians help students with their research questions and course assignments, offer library instruction and orientation sessions, and provide research consultations to individuals and project groups.

The information resources of the library are selected to support WPI courses, projects, research, scholarship, and community interests. In addition to print books, the library offers an extensive collection of over 1 million electronic books and thousands of electronic journals, as well as more than 250 research databases. The library's special book collections include books by WPI faculty authors, recreational reading, music, videos, video games, and board games.

The library catalog, electronic journal and book collections, specialized research databases, course-specific information, and many other resources are available from the library's web site (wpi.edu/library) which features powerful search options and links to research guides, journals, articles, databases, and other digital resources and services. Off-campus access to the library's electronic resources is available with a WPI login or VPN.

Through the Digital WPI platform (digital.wpi.edu), the library collects and offers global digital access to WPI student work including posters created by first year students in the Great Problems Seminar program, IQP and MQP reports, graduate theses and dissertations, as well as selected WPI faculty research.

All students can request materials not held in Gordon Library through a free interlibrary loan service. WPI students also have access to the collections of other academic libraries within Central Massachusetts through the library's membership in the Academic and Research Collaborative (ARC). Students can obtain an ARC cross-borrowing card which allows direct borrowing at many regional academic libraries.

The Archives and Special Collections, located on the ground floor, serves as the institutional memory of WPI and curates the university's collection of manuscripts, rare books, photographs, art, and objects. Our archivists work with the campus community to provide access to historical resources related to WPI, the social and technical stories of the Industrial Revolutions, and regional history. Highlights from the collection include a world-class collection of material related to the life, world, and works of Charles Dickens; selected fine art including prints, paintings, and sculptures; records and publications documenting the history of the university; documentation of the foundations of Fire Protection Engineering; and records of the Morgan Construction Company. These items can be explored through ArchivesSpace (archives.wpi.edu), and are available to researchers by visiting the Fellman Dickens Reading Room, with select digitized and digital-born material hosted at Digital WPI (digital.wpi.edu).

Special exhibits including works by guest and student artists are offered in the library's galleries. WPI authors are regularly invited to talk about their work in the library's Meet the Author series, and other programming occurs regularly to serve the WPI community.

For more information, please visit the library website at wpi.edu/library.

Information Technology Services

Information Technology Services

WPI Information Technology Services (ITS) offers a wide range of information technology resources to the WPI community to support teaching, learning, research and student life.

Access

The WPI account acts as an undergraduate student's WPI virtual identity while the student is actively registered. Usage is governed by the Acceptable Use Policy. The account provides access to many technology resources including:

Network

- Wired and wireless network access available in all academic buildings, residence halls, and participating Greek houses
- High speed Internet connectivity including connection to Internet2
- Virtual Private Network (VPN) secure remote access to WPI on-campus information technology resources

Information Security monitors the WPI network and provides Endpoint Detection and Response for ITS-managed Systems.

University Systems

- University services, such as email, learning management system, eProjects, web site, software applications, remote desktop, databases, etc. are enabled by ITS.
- Workday, and related campus-wide data systems, enable administrative departments to run the critical business functions of the University. They also provide students and faculty access to student registration, advising, and financial information. They enable students to update their biographical information, designate proxy access, and check grades.

Software

Numerous software applications including academic courseware (The WPI Hub | Software Library) are offered for student access:

- in public computer labs
- via remote services
- via network download for some applications
- via discounted purchase at online store

Computer Labs

Over 600 public computers are available across campus for student use. Many are located in open access labs within academic buildings and throughout the Gordon Library. Public computer labs offer a consistent user interface and software profile. Specialty labs for students include:

- Multimedia Lab enabling digital editing and scanning is located in the Gordon Library
- Maker space, prototyping and recording labs are housed in the Innovation Studio
- Design Studio offering powerful workstations for CAD/FEA/FEM projects and coursework is located in Higgins Labs
- Virtual labs with remote access are also available

Printing Services

The Gordon Library Information Commons Print Center is equipped to meet students' scanning and printing needs. Printers are also located throughout the Gordon Library as well as within some computer labs. These additional printing services are detailed in Technology Support and Instruction:

- Large-format poster printing
- Rapid prototyping/3D printing

Collaboration and Learning Resources

Collaboration and learning are supported through specialized software and applications, technology-enhanced spaces, and equipment loans.

- Learning Management Software: Canvas course web sites
- Tools: Microsoft 365 (email/calendar/contact, task, file storage and management, Teams), FusionForge, and CampusPress
- Web-conferencing: Zoom and Teams allow remote participants to conduct real-time meetings in a web-based environment from any location with a web-enabled device and a high speed Internet connection
- Tech Suites: Technology-enhanced meeting spaces with wireless screensharing are designed for student project group use

- Learning Spaces: Active learning classrooms, and technology-enhanced classrooms and conference rooms
- Equipment Loans: Laptops, digital cameras, audio recorders, hard drives, projectors, etc. are available through the Academic Technology Center

Technology Support and Instruction

Technology Service Desk

Gordon Library, Main Floor; (508) 831-5888; hub@wpi.edu; https://hub.wpi.edu

- Offers in-person and remote technology support
- Requests for assistance can be submitted via phone, email or web
- IT Service, Software, and Knowledge Catalog provides answers to common issues

Academic Technology Center (ATC)

Fuller Labs, Room 117; (508) 831-5220; atc@wpi.edu

- In-person technology support on audio-visual equipment loaned out for multi-media projects and campus events sponsored by WPI student organizations
- Large-format poster printing

Academic and Research Computing

Higgins Labs, https://www.wpi.edu/research/resources/support/academic-research-computing

- Instructor-led scientific and engineering software applications training
- Data management and access to cloud collaboration space
- Numerous high performance computational resources available for student research projects
- Large-format poster printing located in Higgins Labs
- Enterprise level rapid prototyping/3D printing located in Higgins Labs

Download as PDF

Office of Accessibility Services

The Office of Accessibility Services (OAS) provides support for WPI students with documented disabilities to equally participate in programs and campus life by putting approved accommodations in place. OAS strives to foster an environment that supports and encourages self-advocacy, independence, and personal growth. Accommodations can be provided to students with disabilities that are permanent in nature as well as temporary when injuries have occurred. More information on how to disclose a disability, documentation guidelines, and general office information can be found at: www.wpi.edu/+accessibility.

OAS services are confidential and available to any student enrolled in a WPI course. Students seeking accommodations or services are responsible for identifying themselves to the OAS as well as providing documentation of their disability by a licensed professional.

OAS is located on the 5th floor of Unity Hall and is open Monday-Friday 8am to 5pm. Please call the office at 508-831-4908 or email accessibilityservices@wpi.edu to schedule an appointment.

Music and Theatre Facilities

Computer Music Laboratories

Alden Memorial and Sanford Riley Hall

These laboratories support creative and research activity in a variety of music- and sound-related applications including real-time virtual orchestra design and production techniques. The lab contains hardware and software for multi-track digital recording and editing, signal processing, algorithmic composition, sound synthesis, MIDI sequencing, music notation, and music programming. The computer music classroom is located in the basement of Alden Hall.

First Baptist Church

The Choral Department is housed in the First Baptist Church, located on the north corner of WPI's campus. Each of the four choirs (Glee Club, Alden Voices, Festival Chorus, and Chamber Choir) hold their weekly rehearsals at the church, along with many a cappella groups. The ensembles regularly rehearse in the spacious and versatile Gordon Hall, while giving three performances a year in the resonant sanctuary. The office for the Director of Choral Activities and choral library are also located within the church.

Alden Hall Theatre Spaces

Alden Memorial: First Floor

Alden Hall houses many of the performance activities at WPI, both academic and extracurricular. The Green Room serves as a space for rehearsals, meetings and other academic projects of the theatre community. It holds various public resources for the WPI theatre community, including plays and reference books. The Great Hall is used for VOX Musical Theatre performances as well as choral and instrumental performances. In addition, the Hall is sometimes used for festive and gala campus functions.

Alden Memorial: Sub-basement

The sub-basement of Alden Hall houses a scenic workshop, as well as storage for props & costumes.

Jazz History Database Lab

The Jazz History Database lab, located in the basement of Alden Hall, is an interactive multimedia museum focused on artists deserving of wider recognition and dedicated to the preservation of "at-risk" jazz artifacts. The rare and unique materials on this website have been contributed by individuals, academics, institutions and media from the U.S. and Internationally. The Jazz History Database is hosted by Worcester Polytechnic Institute (WPI) under the direction of Professor Ben Young, Director. Academic credit is awarded to students working in teams to preserve materials for archiving and inclusion in the database.

The Little Theatre

Sanford-Riley, Lower Level

Made possible with a major gift from the George I. Alden Trust, the Little Theatre is the University's first dedicated academic theatre facility. With a combination of flexible and fixed seating, this 80-111 seat facility has a permanent lighting grid and sound system, a control booth, and a green room/dressing room. The Little Theatre is the laboratory for the Theatre division of the Department of Humanities and Arts.

Music, Perception, and Robotics Lab

Alden Memorial: B21

The Music, Perception and Robotics Lab explores how creative expression can be inspired by and enhanced through technological tools and understanding of human auditory perception. The lab designs, builds, composes for and performs with musical robots. It conducts psychological research that examines human musical perception and creativity. It synthesizes these efforts by developing software that allows human musicians to interact with robotic ones.

Spaulding Recital Hall and Other Rooms for Rehearsal and Performance

Alden Memorial: Lower Level

Alden Center for the Performing Arts houses the Spaulding Recital Hall, Perreault Chamber Rehearsal Room, the Janet Earle Choral Rehearsal Room, three practice rooms, and the Knight Lecture Room. Available for practice are Steinway grand pianos and the Three Manual Aeolian-Skinner pipe organ in the main Concert Hall. There are three concert grand pianos for recitals, ensemble work and concerts. WPI has some instruments that can be made available to students upon request.

Other Music Facilities

Music facilities also include The Janet Earle Room, The Perreault Chamber Rehearsal Room, the music classroom, practice rooms, computer music labs and storage facilities.

Student Development and Counseling Center

The SDCC's team of experienced professionals is here to support your mental health, emotional well-being, and interpersonal growth. We offer a variety of clinical services––including **short-term individual counseling**, **group sessions**, and **crisis interventions**––and will partner with you to identify the tools, resources, and strategies that can help you meet your academic, social, and personal goals. This might take one session, or it might require a little more support. **Either way, you are not alone, and we are here to support you on your WPI journey.**

Some of the ways the SDCC supports students are:

Short-term Individual Counseling: While the length of counseling may differ, all first sessions at the SDCC begin with an Intake Appointment. The intake appointment at the SDCC is typically 25-minutes where you and the therapist will discuss your presenting concern(s), clarify and work on goals for treatment, and then they will work to make a recommendation about next steps. These next steps may include following up as needed, joining a group, helping a student connect with specialists in the area, or other options as appropriate. The SDCC clinician will talk through the Scope of Services with students and recommend next steps.

Confidentiality: The SDCC is dedicated to creating an inclusive, respectful, and comfortable environment where students can share openly and work with counselors to set goals, identify obstacles, and move in a positive direction. Confidentiality is taken very seriously, and only under certain, very specific conditions—outlined in the confidentiality policy (PDF)—will counselors share information outside of the SDCC.

Group Sessions and Workshops: The SDCC offers a variety of groups and workshops focused on student need. These groups may change from term to term. Participating in a therapeutic group can be a helpful resource for students to use both as a stand-alone tool for support, or as an adjunct to individual therapy. Not only will you have the ear of a trained therapist and counselor, but you'll have an opportunity to connect with peers and form new relationships, provide and receive support to/from others, and discover that you are not alone.

Crisis Support: The SDCC can connect students to crisis support options if needed. **If you are on-campus or living close to WPI**: During normal working hours call the SDCC **(508-831-5540)**. Our services are available whether you live on- or off-campus. **If you are off-campus or away from WPI**: Call 911 or go to your nearest emergency room.

After-hours Crisis Support line: Calling ProtoCall **(508-831-5540)** is a great first step, as the crisis counselor you connect with can help you determine if you need a higher level of intervention or not. Call Campus Police or 911 if you are concerned about yourself or the immediate safety of someone else.

We know reaching out for help is not easy. We have added an online scheduling tool to make it easy for students to schedule appointments, and our after-hours telehealth line (508-831-5540) connects students to trained mental health professionals after normal business hours and on weekends/holidays.

Additionally, the SDCC hosts trainings, workshops, and presentations that are designed to foster personal growth and skills for success.

Students interested in learning more about the SDCC and its services are encouraged to email us at sdcc@wpi.edu, call us at 508-831-5540, or visit us during our operating hours. The main office is located at #16 Einhorn Road. We are open Monday-Friday 8am-5pm. Our summer hours are Monday-Friday 8am-4:30 pm.

Academic Departments and Programs

Departments

Major Interdisciplinary Programs

Pre-Professional Programs

Pre-Law Programs
Advisor: K. Rissmiller

Law schools do not require that undergraduates complete any particular course of study. Thus, students who complete degrees in engineering and science (or other WPI programs of study) may wish to consider careers in law. Undergraduates interested in attending law school are encouraged to choose from among the many courses offered which explore legal topics. For those with greater interest, WPI offers a Minor in Law and Technology described on page 121. Courses with substantial legal content are listed among those courses fulfilling the requirements of the minor.

Enrolling in these courses will introduce students to the fundamentals of legal process and legal analysis. Students will study statutes, regulations and case law. These courses will, therefore, offer the student valuable exposure to the kind of material commonly studied in law schools and they may help demonstrate a student's interest to law school admission committees.

Many questions about law school can be answered online. The Law School Admissions Council (LSAC) offers the Law School Admission Test (LSAT) which is generally required for law school applications. Infomation about the test and other aspects of law school can be found on the LSAC website. Students interested in discussing career options and how they might prepare for law school are invited to contact Associate Dean Rissmiller in the Global School.

Pre-Health Programs
ADVISORS: E. Jacoby, A. Holmes

Students at WPI who wish to pursue careers in the health professions (e.g. medicine, dentistry, veterinary medicine, etc.) should, in consultation with their academic advisors, plan their academic programs to include courses in biology, general and organic chemistry, biochemistry, and physics including laboratory experiences. Although required courses for certain majors will naturally overlap with professional school prerequisites more than others, entry into medical or other health professions schools may be accomplished through any major program of study. It is important for students to work closely with their faculty advisors as well as the pre-health advisor to formulate an academic plan of study that will include the courses required for admission to health professions schools while still allowing for completion of all degree requirements. Individual admissions requirements will vary by school and program. Students should consult admissions websites of individual health professions programs for specific information about prerequisites. Pre-med students are encouraged to consult the Medical School Admissions Requirement (MSAR) resource.

WPI's project-focused curriculum offers a tremendous advantage to pre-health students. Health professions programs value teamwork, as well as cross-cultural, research, and community service experience, all of which can be demonstrated through project work. Because students will graduate from WPI with a degree in an academic discipline, they will have other career opportunities should they decide not to pursue a career in a health profession or should they choose to work for some time after graduation before continuing on to a health professions school. Students and alumni applying to health professions schools should plan to meet with the pre-health advisor to discuss the application process and arrange a letter of recommendation from the pre-health committee (if required) to support their application. Such meetings should ideally begin during a student's first year as an undergraduate student (or as soon as a student decides to pursue this path) and continue through their time at WPI.

Teacher Preparation Program
Advisor: Jillian DiBonaventura

Licensed teachers in STEM fields are in continual high demand across the United States. Participation and successful completion of our teacher preparation program will result in obtaining an Initial teaching licensure in the state of Massachusetts. WPI students may elect to pursue licensure in middle or high school mathematics, middle school general science, high school science (Biology, Chemistry, Physics), or technology/engineering while obtaining an undergraduate degree in the STEM-related major of their choice.

Specific content courses are required to meet Massachusetts requirements for Subject Matter Knowledge competency, but these are generally met by courses in a student's major. Joining this certificate program enables participants to pursue the content are of their choice while impacting the lives of middle and high school students in urban schools and the local community. Students wishing to discuss this option further are encouraged to contact Jillian DiBonaventura, Director of Teacher Preparation at the STEM Education Center.

Applications are accepted via eProjects twice yearly (B and C term), and more information can be found on our website or by contacting www.wpi.edu/+teach

https://www.wpi.edu/academics/undergraduate/teacher-preparation-program

Teacher Prep students must successfully complete the following requirements for initial licensure in the state of Massachusetts:

- Completion of an online portfolio that addresses the Candidate Assessment of Performance (CAP) required by the Department of Elementary and Secondary Education (DESE)
- Successful completion of a full-time teaching practicum in a local middle or high school (often completed as an IQP C/D term of junior year)
- Pass the state MTEL teaching tests in the following areas:
  - Communication and Literacy skills (Reading & Writing subtests)
  - Relevant Subject Matter test for the license sought
- Complete all program requirements (Pre-practicum fieldwork and workshops, Culturally Responsive Teaching trainings, Senior seminar and coursework)

Item #	Title	Units
PSY 2401	The Psychology of Education	1/3
	Choose one: PSY 2410, PSY 1401, or PSY 1404	
ID 3100	Teaching Methods in Mathematics and Science	1/3
ID 3200	Sheltered English Immersion Endorsement Course for Teachers	1/3

ROTC

Military Science
LTC Joseph T. Mazzocchi

PROFESSOR: LTC Joseph Mazzocchi

ASSISTANT PROFESSOR: MAJ Daniel Gimm, CPT Patrick Crews

INSTRUCTORS: MSG James Conley, MSG Charles Dougherty, SFC Donald Vota

Mission Statement:

The Military Science and Leadership Program (Army ROTC) is a premiere leadership program offered by WPI. Open to all students within the Worcester Consortium, the program teaches valuable leadership skills and managerial traits that prepare students for careers in both the private and public sectors. Students partake in hands-on experiences that integrate traditional coursework with innovative training. Students develop strong decision-making and organizational management skills, while cultivating team-building and interpersonal skills, as well as mastering time and stress management techniques.

Objectives and Outcomes:

WPI's Army ROTC prepares multi-faceted future leaders. Students who participate in Army ROTC while pursuing their undergraduate and graduate studies are extremely marketable and highly sought after for their problem-solving and adaptable capabilities. As technology continues to transform organizations and corporations, ROTC students are at the forefront of these cutting-edge developments.

Program Descriptions:

The Military Science and Leadership program is intended to be a four-year program which encourages personal growth and cultivates overall character development.

A. The Basic Course:

The Basic Course serves as the foundation of the Army ROTC program and is taken over the first two years. The focal points of the Basic Course are leadership, teambuilding and communication skills. Students participate in adventure training (such as orienteering, rappelling and paintball) to put classroom teachings and core concept-strategies to practice.

Students may participate in the first two years of the program commitment free. Students awarded full-tuition scholarships or who participate in the Advanced Course (described below) incur a service obligation and may serve in the Army either full-time or part-time.

B. Advanced Course:

The Advanced Course is a more intensive leadership program that is taken during the Junior and Senior years, or, during two years of graduate studies. The curriculum continues its focus on problem-solving and team building exercises while incorporating military tactics and Ethics.

Student interested in earning a commission as an Army Officer are required to enroll in the Advanced Camp (AC) at Ft Knox, Kentucky. AC is a six-week leadership and tactical course that students are paid to attend during the summer; it is the culmination of the students' training over their tenure on campus. If students decide later in their academic career that they would like to pursue Army ROTC, there are alternate entry options that allow them to receive Basic Course credit and to prepare them for Advanced Camp (1).

Students attending on an Army ROTC Scholarship receive a yearly book-allowance of $1,200 in addition to a monthly stipend. Both "scholarship" and "contracted, non-scholarship" students receive a monthly stipend of $420.00. Students interested in pursuing scholarships or enrolling in the Advanced Course must meet specific eligibility requirements.

Air Force Aerospace Studies

LT COL C. CUDE, DEPARTMENT HEAD

PROFESSOR: Lt Col C. Cude

ASSISTANT PROFESSORS: Maj K. Blackman, Capt C. Rouleau

Mission

The mission of AFROTC is to develop leaders of character for tomorrow's Air Force and Space Force. The mission of the United States Air Force is to fly, fight and win...airpower anytime, anywhere. The United States Space Force (USSF) is a military service that organizes, trains, and equips space forces in order to protect U.S. and allied interests in space and to provide space capabilities to the joint force. Successful graduates of the program receive a commission as a Second Lieutenant in the United States Air Force or Space Force.

Educational Objectives

Students who successfully complete the AFROTC program will develop:

1. An understanding of the fundamental concepts and principles of Air and Space.
2. A basic understanding of associated professional knowledge.
3. A strong sense of personal integrity, honor, and individual responsibility.
4. An appreciation of the requirements for national security.

Air Force ROTC Programs

There are two traditional routes to an Air Force commission through Air Force ROTC. Entering students may enroll in the Air Force Four-Year Program. Students with at least three academic years remaining in college may apply for the Accelerated Program.

Four- or Five-Year Program

The preferred program is the traditional Four-Year Program. To enroll, simply register for Air Force Aerospace Studies in the fall term of the freshman year in the same manner as other college courses. There is NO MILITARY OBLIGATION for the first two years of Air Force ROTC unless you have an Air Force ROTC scholarship.

The first two years are known as the General Military Course (GMC). Classes meet one hour per week and are required for freshmen and sophomores.

Individuals who successfully complete the GMC compete nationwide for entry into the Professional Officers Course (POC). POC classes meet three hours per week and are required for all juniors and seniors. Officer Candidates enrolled in the POC and on scholarship receive a nontaxable subsistence allowance of up to $500 each month.

Qualified Officer candidates will attend the Air Force ROTC field-training program for four weeks, usually between their sophomore and junior years.

Accelerated Program

For students who do not enroll in Air Force ROTC during their first year in college, it is possible to condense the two years of GMC membership into a single year, as long as the student has three more years of college left.

Other Aspects of the AFROTC Program

Leadership Laboratory:

Air Force ROTC officer candidates participate in a Leadership Laboratory (LLAB) where the leadership skills and management theories acquired in the classroom are put into practice. The LLAB meets once each week for approximately two hours.

This formal military training is largely planned and directed by the officer candidates. The freshmen and sophomores are involved in such initial leadership experiences as problem solving, dynamic leadership, team building, Air Force customs and courtesies, drill movements, Air Force educational benefits, Air Force career opportunities, and preparation for field training. The juniors and seniors are involved in more advanced leadership experiences as they become responsible for the planning and organizing of wing activities, including conducting the Leadership Laboratory itself.

Field Training:

The summer program is designed to develop military leadership, discipline, and evaluate performance. At the same time, the Air Force can evaluate each student's potential as an officer. Field training includes: expeditionary operations, Air Force professional development, marksmanship training, physical fitness, and survival training.

Base Visits:

Air Force ROTC officer candidates may have the opportunity to visit Air Force bases for firsthand observation of the operating Air Force.

Additional Information:

In addition to formal activities, the cadet wing plans and organizes a full schedule of social events throughout the academic year. These include a Dining-In, Military Ball, a Field Day, and intramural sports activities. Professional Development Training Programs, such as Advanced Cyber Education, internships with the National Reconnaissance Office, combative training, and global cultural language and immersion training may also be available to selected volunteer officer candidates during the summer. Students may also participate in Arnold Air Society, Drill Team, and Civil Air Patrol, among other activities.

Other Areas

Degrees

Bioinformatics and Computational Biology

DIRECTOR: D. KORKIN (CS)

ASSOCIATE DIRECTOR: E. RYDER (BB)

PROGRAM COMMITTEE: A. Arnold (MA), L. Harrison (CS), A. Manning (BB), S. Olson (MA), R. Paffenroth (MA), R. Rao (BB), C. Ruiz (CS), B. Servatius (MA), S. Shell (BB), L. Vidali (BB), M. Wu (MA), Z. Wu (MA), E. Young (CHE)

AFFILIATED FACULTY: E. Agu (CS), T. Dominko (BB), M.Y. Eltabakh (CS), W.J. Martin (MA), A. Mattson (CBC), E.A. Rundensteiner (CS), E. Solovey (CS), J. Srinivasan (BB), D. Tang (MA), S. Walcott (MA), A. Yousefi (CS), J. Zou (MA)

Mission Statement

With the advent of large amounts of biological data stemming from research efforts such as the Human Genome Project, there is a great need for professionals who can work at the interface of biology, computer science, and mathematics to address important problems involving complex biological systems. Graduates of this interdisciplinary program will be well versed in all three disciplines, typically specializing in one of them. Many opportunities for interdisciplinary research projects are available, both on the WPI campus, and through relationships with faculty at the University of Massachusetts Medical School. Graduates will be well-prepared for graduate study or for professional careers in industry.

Program Outcomes

Students graduating with a Bachelor of Science degree in Bioinformatics and Computational Biology:

- Have mastered foundational studies in biology, mathematics, and computer science
- Have mastered advanced principles and techniques in at least one of the three disciplines
- Can apply computational and mathematical knowledge to the solution of biological problems
- Can communicate effectively across disciplines both verbally and in writing
- Can locate, read, and interpret primary literature in bioinformatics and computational biology
- Can formulate hypotheses or models, design experiments to test these hypotheses, and interpret experimental data
- Can function effectively as members of an interdisciplinary team
- Adhere to accepted standards of ethical and professional behavior
- Will be life-long independent learners

Bioinformatics and Computational Biology Major

Degree Type

Bachelor of Science

Program Distribution Requirements for the Bioinformatics and Computational Biology Major

Mathematics (Minimum 5/3 Units)

Mathematics must include 3/3 unit of differential and integral calculus and statistics. The additional 2/3 unit must be chosen from linear algebra, statistics, probability, calculus, and differential equations.

1000 Level Mathematics Courses

Item #	Title	Units
MA 1020	Calculus I with Preliminary Topics	1/3
MA 1021	Calculus I	1/3
MA 1022	Calculus II	1/3
MA 1023	Calculus III	1/3
MA 1024	Calculus IV	1/3
MA 1033	Theoretical Calculus III	1/3
MA 1034	Theoretical Calculus IV	1/3
MA 1120	Calculus II (Semester Version)	1/3
MA 1801	Denksport	1/12
MA 1971	Bridge to Higher Mathematics	1/3

2000 Level Mathematics Courses

Item #	Title	Units
CS 2022/MA 2201	Discrete Mathematics	1/3
MA 2051	Ordinary Differential Equations	1/3
MA 2071	Matrices and Linear Algebra I	1/3
MA 2072	Accelerated Matrices and Linear Algebra I	1/3
MA 2073	Matrices and Linear Algebra II	1/3
MA 2210	Mathematical Methods in Decision Making	1/3
MA 2211	Theory of Interest I	1/3
MA 2212	Theory of Interest II	1/3
MA 2251	Vector and Tensor Calculus	1/3
MA 2271	Graph Theory	1/3
MA 2273	Combinatorics	1/3
MA 2431	Mathematical Modeling with Ordinary Differential Equations	1/3
MA 2610	Applied Statistics for the Life Sciences	1/3
MA 2611	Applied Statistics I	1/3
MA 2612	Applied Statistics II	1/3
MA 2621	Probability for Applications	1/3
MA 2631	Probability Theory	1/3

3000 Level Mathematics Courses

Item #	Title	Units
CS 4032/MA 3257	Numerical Methods for Linear and Nonlinear Systems	1/3
CS 4033/MA 3457	Numerical Methods for Calculus and Differential Equations	1/3
MA 3212	Actuarial Mathematics I	1/3
MA 3213	Actuarial Mathematics II	1/3
MA 3231	Linear Programming	1/3
MA 3233	Discrete Optimization	1/3
MA 3457/CS 4033	Numerical Methods for Calculus and Differential Equations	1/3
MA 3471	Advanced Ordinary Differential Equations	1/3
MA 3475	Calculus of Variations	1/3
MA 3627	Introduction to the Design and Analysis of Experiments	1/3
MA 3631	Mathematical Statistics	1/3
MA 3823	Group Theory	1/3
MA 3825	Rings and Fields	1/3
MA 3831	Principles of Real Analysis I	1/3
MA 3832	Principles of Real Analysis II	1/3

4000 Level Mathematics Courses

Item #	Title	Units
BCB 4004/MA 4603	Statistical Methods in Genetics and Bioinformatics	1/3
DS 4635/MA 4635	Data Analytics and Statistical Learning	1/3
MA 4213	Loss Models I - Risk Theory	1/3
MA 4214	Loss Models II - Survival Models	1/3
MA 4216	Actuarial Seminar	
MA 4222	Top Algorithms in Applied Mathematics	1/3
MA 4235	Mathematical Optimization	1/3
MA 4237	Probabilistic Methods in Operations Research	1/3
MA 4291	Applied Complex Variables	1/3
MA 4411	Numerical Analysis of Differential Equations	1/3
MA 4451	Boundary Value Problems	1/3
MA 4473	Partial Differential Equations	1/3
MA 4631	Probability and Mathematical Statistics I	1/3
MA 4632	Probability and Mathematical Statistics II	1/3
MA 4891	Topics in Mathematics	1/3
MA 4892	Topics in Actuarial Mathematics	1/3
MA 4895	Differential Geometry	1/3

Computer Science (Minimum 4/3 Units)

Computer Science must include 2/3 unit of introductory programming and 2/3 unit of discrete math and algorithms.

1000 Level Computer Science

Item #	Title	Units
CS 1004	Introduction to Programming for Non-Majors	1/3
CS 1101	Introduction to Program Design	1/3
CS 1102	Accelerated Introduction to Program Design	1/3

2000 Level Computer Science

Item #	Title	Units
CS 2011	Introduction to Machine Organization and Assembly Language	1/3
CS 2022/MA 2201	Discrete Mathematics	1/3
CS 2102	Object-Oriented Design Concepts	1/3
CS 2103	Accelerated Object-Oriented Design Concepts	1/3
CS 2119	Application Building with Object-Oriented Concepts	1/3
CS 2223	Algorithms	1/3
CS 2301	Systems Programming for Non-Majors	1/3
CS 2303	Systems Programming Concepts	1/3

3000 Level Computer Science

Item #	Title	Units
CS 3013	Operating Systems	1/3
CS 3041	Human-Computer Interaction	1/3
CS 3043	Social Implications of Information Processing	1/3
CS 3133	Foundations of Computer Science	1/3
CS 3431	Database Systems I	1/3
CS 3516	Computer Networks	1/3
CS 3733	Software Engineering	1/3

4000 Level Computer Science

Item #	Title	Units
BCB 4002/CS 4802	Biovisualization	1/3
BCB 4003/CS 4803	Biological and Biomedical Database Mining	1/3
CS 4032/MA 3257	Numerical Methods for Linear and Nonlinear Systems	1/3
CS 4033/MA 3457	Numerical Methods for Calculus and Differential Equations	1/3
CS 4099	Special Topics in Computer Science	1/3
CS 4100/IMGD 4100	Artificial Intelligence for Interactive Media and Games	1/3
CS 4120	Analysis of Algorithms	1/3
CS 4123	Theory of Computation	1/3
CS 4233	Object-Oriented Analysis and Design	1/3
CS 4241	Webware: Computational Technology for Network Information Systems	1/3
CS 4300/IMGD 4300	Graphics, Simulation, and Aesthetics	1/3
CS 4341	Introduction to Artificial Intelligence	1/3
CS 4342	Machine Learning	1/3
CS 4401	Software Security Engineering	1/3
CS 4404	Tools and Techniques in Computer Network Security	1/3
CS 4432	Database Systems II	1/3
CS 4433/DS 4433	Big Data Management and Analytics	1/3
CS 4445	Data Mining and Knowledge Discovery in Databases	1/3
CS 4513	Distributed Computing Systems	1/3
CS 4515	Computer Architecture	1/3
CS 4516	Advanced Computer Networks	1/3
CS 4518	Mobile and Ubiquitous Computing	1/3
CS 4533	Techniques of Programming Language Translation	1/3
CS 4536	Programming Languages	1/3
CS 4731	Computer Graphics	1/3
CS 4732	Computer Animation	1/3
CS 4801/ECE 4802	Introduction to Cryptography and Communication Security	1/3
CS 4804	Data Visualization	1/3
MA 3457/CS 4033	Numerical Methods for Calculus and Differential Equations	1/3

Biology (Minimum 5/3 Units)

Biology must include cell biology, genetics, molecular biology, and 1/3 unit BB 2000-level laboratory.

1000 Level Biology and Biotechnology Courses

Item #	Title	Units
BB 1001	Introduction to Biology	1/3
BB 1002	Environmental Biology	1/3
BB 1003/BCB 1003	Exploring Bioinformatics and Computational Biology	1/3
BB 1025	Human Biology	1/3
BB 1035	Biotechnology	1/3
BB 1045	Biodiversity	1/3

2000 Level Biology and Biotechnology Courses

Item #	Title	Units
BB 2002	Microbiology	1/3
BB 2003	Fundamentals of Microbiology	1/3
BB 2030	Plant Diversity	1/3
BB 2040	Principles of Ecology	1/3
BB 2050	Animal Behavior	1/3
BB 2550	Cell Biology	1/3
BB 2902	Enzymes, Proteins, and Purification	1/6
BB 2903	Anatomy and Physiology	1/6
BB 2904	Ecology, Environment, and Animal Behavior	1/6
BB 2915	Searching for Solutions in Soil: Microbial and Molecular Investigations	1/3
BB 2917	Hunting for Phage	1/3
BB 2920	Genetics	1/3
BB 2950	Molecular Biology	1/3

3000 Level Biology and Biotechnology Courses

Item #	Title	Units
BB 3003	Medical Microbiology: Plagues of the Modern World, a Case Study Approach	1/3
BB 3010/BCB 3010	Simulation in Biology	1/3
BB 3050	Cancer Biology	1/3
BB 3080	Neurobiology	1/3
BB 3101	Human Anatomy & Physiology: Movement and Communication	1/3
BB 3102	Human Anatomy & Physiology: Transport and Maintenance	1/3
BB 3120	Plant Physiology	1/3
BB 3140	Evolution: Pattern and Process	1/3
BB 3512	Molecular Genetics Lab	1/6
BB 3513	Cell Culture Techniques for Animal Cells	1/6
BB 3515	Physiologic Systems Laboratory	1/3
BB 3517	Fermentation	1/6
BB 3519	Protein Purification	1/6
BB 3521	Microscopy	1/6
BB 3525	Plant Physiology	1/6
BB 3526	Phage Hunters: the Analysis	1/6
BB 3527	Molecular Biology and Genetic Engineering: Approaches and Applications	1/3
BB 3530	Immunotherapies: The Next Generation of Pharmaceuticals	1/3
BB 3570	Cell Culture Models for Tissue Regeneration	1/3
BB 3620	Developmental Biology	1/3
BB 3920	Immunology	1/3

4000 Level Biology and Biotechnology Courses

Item #	Title	Units
BB 4150	Environmental Change: Problems and Approaches	1/3
BB 4170/CH 4170	Experimental Genetic Engineering	1/3
BB 4190/CH 4190	Regulation of Gene Expression	1/3
BB 4260	Synthetic Biology	1/3
BB 4801/BCB 4001	Bioinformatics	1/3
BB 4900	Capstone Experience in Biology and Biotechnology	1/3

Chemistry (Minimum 4/3 Units)

Chemistry must include 2/3 unit of general chemistry and 2/3 unit of organic chemistry.

1000 Level Chemistry Courses

Item #	Title	Units
CH 1010	Chemical Properties, Bonding, and Forces	1/3
CH 1020	Chemical Reactions	1/3
CH 1030	Kinetics, Equilibrium and Thermodynamics	1/3
CH 1040	Spectroscopy in Organic and Polymer Chemistry	1/3

2000 Level Chemistry Courses

Item #	Title	Units
CH 2310	Organic Chemistry I	1/3
CH 2320	Organic Chemistry II	1/3
CH 2330	Organic Chemistry III	1/3
CH 2360	Organic Laboratory	1/3
CH 2640	Experimental Chemistry I: Instrumental Analysis	1/3
CH 2650	Modern Physical Chemistry Methods	1/3
CH 2660	Organic Synthesis and Analysis Laboratory	1/3
CH 2670	Investigation of Coordination Complexes Through Inquiry	1/3

3000 Level Chemistry Courses

Item #	Title	Units
CH 3310	Advanced Organic Chemistry	1/3
CH 3410	Structure, Bonding, and Reactivity in Inorganic Chemistry	1/3
CH 3510	Chemical Thermodynamics	1/3
CH 3530	Quantum Chemistry	1/3
CH 3550	Chemical Dynamics	1/3

4000 Level Chemistry Courses

Item #	Title	Units
BB 4170/CH 4170	Experimental Genetic Engineering	1/3
BB 4190/CH 4190	Regulation of Gene Expression	1/3
CH 4110	Protein Structure and Function	1/3
CH 4120	Lipids and Biomembrane Functions	1/3
CH 4130	Nucleic Acids and Bioinformation	1/3
CH 4140	Metabolism and Disease	1/3
CH 4150	Enzymology and Protein Characterization Laboratory	1/3
CH 4160	Membrane Biophysics	1/3
CH 4330	Organic Synthesis	1/3
CH 4420	Principles and Applications of Group Theory in Chemistry	1/3
CH 4520	Chemical Statistical Mechanics	1/3

Bioinformatics and Computational Biology (Minimum 3/3 Units)

Chosen from BCB interdisciplinary courses.

1000 Level Bioinformatics and Computational Biology Courses

Item #	Title	Units
BB 1003/BCB 1003	Exploring Bioinformatics and Computational Biology	1/3

2000 Level Bioinformatics and Computational Biology Courses

3000 Level Bioinformatics and Computational Biology Courses

Item #	Title	Units
BB 3010/BCB 3010	Simulation in Biology	1/3

4000 Level Bioinformatics and Computational Biology Courses

Item #	Title	Units
BB 4801/BCB 4001	Bioinformatics	1/3
BCB 4002/CS 4802	Biovisualization	1/3
BCB 4003/CS 4803	Biological and Biomedical Database Mining	1/3
BCB 4004/MA 4603	Statistical Methods in Genetics and Bioinformatics	1/3

Social Implications (Minimum 1/3 Units)

Chosen from CS 3043 or PY 2713.

Item #	Title	Units
CS 3043	Social Implications of Information Processing	1/3
PY 2713	Bioethics	1/3

Advanced Disciplinary Courses (Minimum 6/3 Units)

Chosen from advanced courses in MA, CS, BB, or CH listed below. At least one unit must be within one area (MA, CS, or BB/CH). At least one unit must be at the 4000 level (may be in different areas).

Advanced Courses in MA

Item #	Title	Units
CS 4032/MA 3257	Numerical Methods for Linear and Nonlinear Systems	1/3
CS 4033/MA 3457	Numerical Methods for Calculus and Differential Equations	1/3
MA 2431	Mathematical Modeling with Ordinary Differential Equations	1/3
MA 2621	Probability for Applications	1/3
MA 2631	Probability Theory	1/3
MA 3457/CS 4033	Numerical Methods for Calculus and Differential Equations	1/3
MA 3627	Introduction to the Design and Analysis of Experiments	1/3
MA 3631	Mathematical Statistics	1/3
MA 4214	Loss Models II - Survival Models	1/3
MA 4473	Partial Differential Equations	1/3
MA 4631	Probability and Mathematical Statistics I	1/3
MA 4632	Probability and Mathematical Statistics II	1/3

Advanced Courses in CS

Item #	Title	Units
CS 3431	Database Systems I	1/3
CS 3733	Software Engineering	1/3
CS 4120	Analysis of Algorithms	1/3
CS 4341	Introduction to Artificial Intelligence	1/3
CS 4342	Machine Learning	1/3
CS 4432	Database Systems II	1/3
CS 4445	Data Mining and Knowledge Discovery in Databases	1/3

Advanced Courses in BB/CH

Any BB 3000/4000 level course or CH 4000 level Biochemistry course.

Particularly relevant BB/CH courses:

Item #	Title	Units
BB 3140	Evolution: Pattern and Process	1/3
BB 4190/CH 4190	Regulation of Gene Expression	1/3
CH 4110	Protein Structure and Function	1/3
CH 4120	Lipids and Biomembrane Functions	1/3
CH 4130	Nucleic Acids and Bioinformation	1/3

Major Qualifying Project (Minimum 3/3 Units)

Bioinformatics and Computational Biology Minor

Degree Type

Minor

Students pursuing the Bioinformatics and Computational Biology minor need to acquire some familiarity with the three fields that form the basis of this interdisciplinary area: biology, mathematics, and computer science. They should also take at least one interdisciplinary course that uses quantitative methods to pose and answer biological problems. Students should be careful to choose their mathematics, computer science, and biology courses to prepare themselves for whichever capstone BCB course they plan to take.

Program Requirements for Bioinformatics and Computational Biology Minor

BB, MA, CS, and BCB, chosen from the course lists below (Minimum 5/3 Units)

With at least 1/3 unit in each of BB, MA, and CS, and no more than 2/3 unit from any of these three areas. No more than 1 course at the 1000 level may be included from any one department.

BB Courses

Item #	Title	Units
BB 1025	Human Biology	1/3
BB 1035	Biotechnology	1/3
BB 1045	Biodiversity	1/3
BB 2002	Microbiology	1/3
BB 2040	Principles of Ecology	1/3
BB 2550	Cell Biology	1/3
BB 2920	Genetics	1/3
BB 2950	Molecular Biology	1/3
BB 3140	Evolution: Pattern and Process	1/3
BB 4190/CH 4190	Regulation of Gene Expression	1/3
CH 4110	Protein Structure and Function	1/3
CH 4120	Lipids and Biomembrane Functions	1/3
CH 4130	Nucleic Acids and Bioinformation	1/3

MA Courses

Item #	Title	Units
MA 2051	Ordinary Differential Equations	1/3
MA 2431	Mathematical Modeling with Ordinary Differential Equations	1/3
MA 2610	Applied Statistics for the Life Sciences	1/3
MA 2612	Applied Statistics II	1/3
MA 2621	Probability for Applications	1/3
MA 2631	Probability Theory	1/3
MA 3627	Introduction to the Design and Analysis of Experiments	1/3
MA 3631	Mathematical Statistics	1/3
MA 4214	Loss Models II - Survival Models	1/3
MA 4473	Partial Differential Equations	1/3
MA 4631	Probability and Mathematical Statistics I	1/3
MA 4632	Probability and Mathematical Statistics II	1/3

CS Courses

Item #	Title	Units
CS 1004	Introduction to Programming for Non-Majors	1/3
CS 1101	Introduction to Program Design	1/3
CS 2102	Object-Oriented Design Concepts	1/3
CS 2223	Algorithms	1/3
CS 3431	Database Systems I	1/3
CS 3733	Software Engineering	1/3
CS 4120	Analysis of Algorithms	1/3
CS 4341	Introduction to Artificial Intelligence	1/3
CS 4432	Database Systems II	1/3
CS 4445	Data Mining and Knowledge Discovery in Databases	1/3

BCB Courses

Item #	Title	Units
BB 1003/BCB 1003	Exploring Bioinformatics and Computational Biology	1/3
BB 3010/BCB 3010	Simulation in Biology	1/3
BB 4801/BCB 4001	Bioinformatics	1/3
BCB 4002/CS 4802	Biovisualization	1/3
BCB 4003/CS 4803	Biological and Biomedical Database Mining	1/3
BCB 4004/MA 4603	Statistical Methods in Genetics and Bioinformatics	1/3

Capstone (Minimum 1/3 Units)

Any BCB 3000 or 4000-level class.

Item #	Title	Units
BB 3010/BCB 3010	Simulation in Biology	1/3
BB 4801/BCB 4001	Bioinformatics	1/3
BCB 4002/CS 4802	Biovisualization	1/3
BCB 4003/CS 4803	Biological and Biomedical Database Mining	1/3
BCB 4004/MA 4603	Statistical Methods in Genetics and Bioinformatics	1/3

Biology and Biotechnology

R. RAO, HEAD

PROFESSORS: T. Dominko, J. King, K. Oates, R. Rao, E. Ryder, L. Vidali P. J. Weathers

TEACHING PROFESSOR: M. Buckholt

ASSOCIATE PROFESSORS: J. Duffy, A. Manning, L. Mathews, J. Rulfs, S. Shell, J. Srinivasan

ASSOCIATE PROFESSOR of TEACHING: L. Roberts

ASSOCIATE TEACHING PROFESSOR: M. Bakermans, C. Collins

ASSISTANT PROFESSORS: N. Farny, S. McInally, I. Nechipurenko

PROFESSOR OF PRACTICE: F. Brownewell

ASSISTANT RESEARCH PROFESSOR: B. Nephew

AFFILIATE FACULTY: D. Albrecht, A. Rodriguez

Mission Statement

OUR MISSION is to deliver the highest quality Life Science education through including project-based learning, foster research that enriches our understanding of life's principles and impacts health and to build a community that nurtures a sense of collegiality and shared responsibility.

OUR VISION is to cultivate scientific literacy and curiosity among students and to generate new knowledge through our research that drives change for the better.

OUR Values are centered around knowledge, skill and community.

OUR COMMUNITY includes undergraduates (our best ambassadors, tuition driven institution), Masters' students (work force development), Doctoral students (research), K-12 (pipeline, outreach), alumni, faculty, staff, and parents.

Educational Program

Our educational program is founded in five unifying concepts.

1. All living things evolve through processes such as genetic drift and natural selection that act on heritable genetic variation.
2. Biological systems obey the principles of chemistry and physics.
3. Simple biological units can assemble into more complex systems with emergent properties.
4. Biological systems function by the actions of complex regulatory systems.
5. Scientific knowledge follows a process of observation and hypothesis testing.

An integrated and functional understanding of these concepts provides the foundation for biotechnology, the technological application of biological systems, living organisms or derivatives thereof, to make or modify products or processes for specific use. (United Nations Convention on Biological Diversity)

In the Biology & Biotechnology curriculum, these concepts are exemplified and integrated across three major divisions of biology:

- Cellular and molecular biology
- Biology of the organism
- Organisms in their environment

Program Learning Outcomes

The program's learning outcomes are designed to support life-long learning in the discipline. Toward that end, graduates of WPI with a Bachelor of Science degree in Biology & Biotechnology

- will know and understand the five unifying themes and can provide and explain examples of each from each of the three divisions of biology.
- can demonstrate mastery of a range of quantitative and procedural skills applicable to research and practice in biology & biotechnology.
- are able to generate hypotheses, design approaches to test them, and interpret data to reach valid conclusions.
- can find, read and critically evaluate the scientific literature.
- can describe the broader scientific or societal context of their work or that of others.
- demonstrate oral and written communication skills relevant to the discipline.
- can function effectively in a collaborative scientific environment.
- understand and can adhere to accepted standards of intellectual honesty in formulating, conducting and presenting their work.

Biology and Biotechnology Major

Degree Type

Bachelor of Science

Program Distribution Requirements for the Biology and Biotechnology Major

Mathematical Sciences, Physics, Computer Science, Engineering (Minimum 5/3 Units)

BB 3010 and BB 4801 may count toward this requirement.

All Mathematics courses

Item #	Title	Units
BCB 4004/MA 4603	Statistical Methods in Genetics and Bioinformatics	1/3
CS 2022/MA 2201	Discrete Mathematics	1/3
CS 4032/MA 3257	Numerical Methods for Linear and Nonlinear Systems	1/3
CS 4033/MA 3457	Numerical Methods for Calculus and Differential Equations	1/3
DS 4635/MA 4635	Data Analytics and Statistical Learning	1/3
MA 1020	Calculus I with Preliminary Topics	1/3
MA 1021	Calculus I	1/3
MA 1022	Calculus II	1/3
MA 1023	Calculus III	1/3
MA 1024	Calculus IV	1/3
MA 1033	Theoretical Calculus III	1/3
MA 1034	Theoretical Calculus IV	1/3
MA 1120	Calculus II (Semester Version)	1/3
MA 1801	Denksport	1/12
MA 1971	Bridge to Higher Mathematics	1/3
MA 2051	Ordinary Differential Equations	1/3
MA 2071	Matrices and Linear Algebra I	1/3
MA 2072	Accelerated Matrices and Linear Algebra I	1/3
MA 2073	Matrices and Linear Algebra II	1/3
MA 2210	Mathematical Methods in Decision Making	1/3
MA 2211	Theory of Interest I	1/3
MA 2212	Theory of Interest II	1/3
MA 2251	Vector and Tensor Calculus	1/3
MA 2271	Graph Theory	1/3
MA 2273	Combinatorics	1/3
MA 2431	Mathematical Modeling with Ordinary Differential Equations	1/3
MA 2610	Applied Statistics for the Life Sciences	1/3
MA 2611	Applied Statistics I	1/3
MA 2612	Applied Statistics II	1/3
MA 2621	Probability for Applications	1/3
MA 2631	Probability Theory	1/3
MA 3212	Actuarial Mathematics I	1/3
MA 3213	Actuarial Mathematics II	1/3
MA 3231	Linear Programming	1/3
MA 3233	Discrete Optimization	1/3
MA 3457/CS 4033	Numerical Methods for Calculus and Differential Equations	1/3
MA 3471	Advanced Ordinary Differential Equations	1/3
MA 3475	Calculus of Variations	1/3
MA 3627	Introduction to the Design and Analysis of Experiments	1/3
MA 3631	Mathematical Statistics	1/3
MA 3823	Group Theory	1/3
MA 3825	Rings and Fields	1/3
MA 3831	Principles of Real Analysis I	1/3
MA 3832	Principles of Real Analysis II	1/3
MA 4213	Loss Models I - Risk Theory	1/3
MA 4214	Loss Models II - Survival Models	1/3
MA 4216	Actuarial Seminar	
MA 4222	Top Algorithms in Applied Mathematics	1/3
MA 4235	Mathematical Optimization	1/3
MA 4237	Probabilistic Methods in Operations Research	1/3
MA 4291	Applied Complex Variables	1/3
MA 4411	Numerical Analysis of Differential Equations	1/3
MA 4451	Boundary Value Problems	1/3

MA 4473	Partial Differential Equations	1/3
MA 4631	Probability and Mathematical Statistics I	1/3
MA 4632	Probability and Mathematical Statistics II	1/3
MA 4891	Topics in Mathematics	1/3
MA 4892	Topics in Actuarial Mathematics	1/3
MA 4895	Differential Geometry	1/3

All Physics Courses

Item #	Title	Units
PH 1110	General Physics—Mechanics	1/3
PH 1111	Principles of Physics—Mechanics	1/3
PH 1120	General Physics—Electricity and Magnetism	1/3
PH 1121	Principles of Physics—Electricity and Magnetism	1/3
PH 1130	Modern Physics	1/3
PH 1140	Oscillations and Waves	1/3
PH 1150	Introductory Physics of Living Systems	1/3
PH 2101	Principles of Thermodynamics	1/3
PH 2201	Intermediate Mechanics I	1/3
PH 2202	Intermediate Mechanics II	1/3
PH 2301	Electromagnetic Fields	1/3
PH 2501	Photonics	1/3
PH 2502	Lasers	1/3
PH 2510	Atomic Force Microscopy	1/3
PH 2520	Introduction to Astrophysics	1/3
PH 2540	Solar Systems	1/3
PH 2550/AE 2550	Atmospheric and Space Environments	1/3
PH 2601	Photonics Laboratory	1/3
PH 2651	Intermediate Physics Laboratory	1/3
PH 3206	Statistical Physics	1/3
PH 3301	Electromagnetic Theory	1/3
PH 3401	Quantum Mechanics I	1/3
PH 3402	Quantum Mechanics II	1/3
PH 3501	Relativity	1/3
PH 3502	Solid State Physics	1/3
PH 3503	Nuclear Physics	1/3
PH 3504	Optics	1/3
PH 4201/PH 511	Advanced Classical Mechanics	1/3

All Computer Science courses

Item #	Title	Units
BCB 4002/CS 4802	Biovisualization	1/3
BCB 4003/CS 4803	Biological and Biomedical Database Mining	1/3
CS 1004	Introduction to Programming for Non-Majors	1/3
CS 1101	Introduction to Program Design	1/3
CS 1102	Accelerated Introduction to Program Design	1/3
CS 2011	Introduction to Machine Organization and Assembly Language	1/3
CS 2022/MA 2201	Discrete Mathematics	1/3
CS 2102	Object-Oriented Design Concepts	1/3
CS 2103	Accelerated Object-Oriented Design Concepts	1/3
CS 2119	Application Building with Object-Oriented Concepts	1/3
CS 2223	Algorithms	1/3
CS 2301	Systems Programming for Non-Majors	1/3
CS 2303	Systems Programming Concepts	1/3
CS 3013	Operating Systems	1/3
CS 3041	Human-Computer Interaction	1/3
CS 3043	Social Implications of Information Processing	1/3
CS 3133	Foundations of Computer Science	1/3
CS 3431	Database Systems I	1/3
CS 3516	Computer Networks	1/3
CS 3733	Software Engineering	1/3
CS 4032/MA 3257	Numerical Methods for Linear and Nonlinear Systems	1/3
CS 4033/MA 3457	Numerical Methods for Calculus and Differential Equations	1/3
CS 4099	Special Topics in Computer Science	1/3
CS 4100/IMGD 4100	Artificial Intelligence for Interactive Media and Games	1/3
CS 4120	Analysis of Algorithms	1/3
CS 4123	Theory of Computation	1/3
CS 4233	Object-Oriented Analysis and Design	1/3
CS 4241	Webware: Computational Technology for Network Information Systems	1/3
CS 4300/IMGD 4300	Graphics, Simulation, and Aesthetics	1/3
CS 4341	Introduction to Artificial Intelligence	1/3
CS 4342	Machine Learning	1/3
CS 4401	Software Security Engineering	1/3
CS 4404	Tools and Techniques in Computer Network Security	1/3
CS 4432	Database Systems II	1/3
CS 4433/DS 4433	Big Data Management and Analytics	1/3
CS 4445	Data Mining and Knowledge Discovery in Databases	1/3
CS 4513	Distributed Computing Systems	1/3
CS 4515	Computer Architecture	1/3
CS 4516	Advanced Computer Networks	1/3
CS 4518	Mobile and Ubiquitous Computing	1/3
CS 4533	Techniques of Programming Language Translation	1/3
CS 4536	Programming Languages	1/3
CS 4731	Computer Graphics	1/3
CS 4732	Computer Animation	1/3
CS 4801/ECE 4802	Introduction to Cryptography and Communication Security	1/3
CS 4804	Data Visualization	1/3
MA 3457/CS 4033	Numerical Methods for Calculus and Differential Equations	1/3

All Engineering courses

BB 3010 and BB 4801

Item #	Title	Units
BB 4801/BCB 4001	Bioinformatics	1/3

Chemistry (Minimum 5/3 Units)

All Chemistry courses

Item #	Title	Units
BB 4170/CH 4170	Experimental Genetic Engineering	1/3
BB 4190/CH 4190	Regulation of Gene Expression	1/3
CH 1010	Chemical Properties, Bonding, and Forces	1/3
CH 1020	Chemical Reactions	1/3
CH 1030	Kinetics, Equilibrium and Thermodynamics	1/3
CH 1040	Spectroscopy in Organic and Polymer Chemistry	1/3
CH 2310	Organic Chemistry I	1/3
CH 2320	Organic Chemistry II	1/3
CH 2330	Organic Chemistry III	1/3
CH 2360	Organic Laboratory	1/3
CH 2640	Experimental Chemistry I: Instrumental Analysis	1/3
CH 2650	Modern Physical Chemistry Methods	1/3
CH 2660	Organic Synthesis and Analysis Laboratory	1/3
CH 2670	Investigation of Coordination Complexes Through Inquiry	1/3
CH 3310	Advanced Organic Chemistry	1/3
CH 3410	Structure, Bonding, and Reactivity in Inorganic Chemistry	1/3
CH 3510	Chemical Thermodynamics	1/3
CH 3530	Quantum Chemistry	1/3
CH 3550	Chemical Dynamics	1/3
CH 4110	Protein Structure and Function	1/3
CH 4120	Lipids and Biomembrane Functions	1/3
CH 4130	Nucleic Acids and Bioinformation	1/3
CH 4140	Metabolism and Disease	1/3
CH 4150	Enzymology and Protein Characterization Laboratory	1/3
CH 4160	Membrane Biophysics	1/3
CH 4330	Organic Synthesis	1/3
CH 4420	Principles and Applications of Group Theory in Chemistry	1/3
CH 4520	Chemical Statistical Mechanics	1/3

Biology & Biotechnology (Minimum 10/3 Units)

Biology and Biotechnology coursework must include 2/3 units at the 1000 level, 4/3 units at the 2000 level, and 4/3 units at the 3000/4000 level, of which at least 1/3 unit must be a BB 4900 course. BB 1000, BB 1001, BB 1002 and BB/BCB 1003 may not count toward the major requirement.

At least 2/3 unit of Biology and Biotechnology coursework must be taken from each of three major divisions of biology (below). The 2/3 unit for each division may include courses from any level (1000-4000).

1000 Level Biology and Biotechnology Courses

Item #	Title	Units
BB 1001	Introduction to Biology	1/3
BB 1002	Environmental Biology	1/3
BB 1003/BCB 1003	Exploring Bioinformatics and Computational Biology	1/3
BB 1025	Human Biology	1/3
BB 1035	Biotechnology	1/3
BB 1045	Biodiversity	1/3

2000 Level Biology and Biotechnology Courses

Item #	Title	Units
BB 2002	Microbiology	1/3
BB 2003	Fundamentals of Microbiology	1/3
BB 2030	Plant Diversity	1/3
BB 2040	Principles of Ecology	1/3
BB 2050	Animal Behavior	1/3
BB 2550	Cell Biology	1/3
BB 2902	Enzymes, Proteins, and Purification	1/6
BB 2903	Anatomy and Physiology	1/6
BB 2904	Ecology, Environment, and Animal Behavior	1/6
BB 2915	Searching for Solutions in Soil: Microbial and Molecular Investigations	1/3
BB 2917	Hunting for Phage	1/3
BB 2920	Genetics	1/3
BB 2950	Molecular Biology	1/3

3000+ Level Biology and Biotechnology Courses

Item #	Title	Units
BB 3003	Medical Microbiology: Plagues of the Modern World, a Case Study Approach	1/3
BB 3010/BCB 3010	Simulation in Biology	1/3
BB 3050	Cancer Biology	1/3
BB 3080	Neurobiology	1/3
BB 3101	Human Anatomy & Physiology: Movement and Communication	1/3
BB 3102	Human Anatomy & Physiology: Transport and Maintenance	1/3
BB 3120	Plant Physiology	1/3
BB 3140	Evolution: Pattern and Process	1/3
BB 3512	Molecular Genetics Lab	1/6
BB 3513	Cell Culture Techniques for Animal Cells	1/6
BB 3515	Physiologic Systems Laboratory	1/3
BB 3517	Fermentation	1/6
BB 3519	Protein Purification	1/6
BB 3521	Microscopy	1/6
BB 3525	Plant Physiology	1/6
BB 3526	Phage Hunters: the Analysis	1/6
BB 3527	Molecular Biology and Genetic Engineering: Approaches and Applications	1/3
BB 3530	Immunotherapies: The Next Generation of Pharmaceuticals	1/3
BB 3570	Cell Culture Models for Tissue Regeneration	1/3
BB 3620	Developmental Biology	1/3
BB 3920	Immunology	1/3
BB 4150	Environmental Change: Problems and Approaches	1/3
BB 4170/CH 4170	Experimental Genetic Engineering	1/3
BB 4190/CH 4190	Regulation of Gene Expression	1/3
BB 4260	Synthetic Biology	1/3
BB 4801/BCB 4001	Bioinformatics	1/3
BB 4900	Capstone Experience in Biology and Biotechnology	1/3

Laboratory Experience (Minimum 4/3 Units)

Student has completed 7.5 Credits of Laboratory Courses (From All BB Lab 2000 Level or Above, CH 4150 or CH 4170).

Note: Students may only complete 3 Credits of CH 4150, CH 4170, BB 3516, BB 3518, BB 3519. Students may only complete 3 Credits of CH 4170, BB 3512, BB 3518 or BB 3520.

2000+ Level Biology and Biotechnology Courses

Item #	Title	Units
BB 2002	Microbiology	1/3
BB 2003	Fundamentals of Microbiology	1/3
BB 2030	Plant Diversity	1/3
BB 2040	Principles of Ecology	1/3
BB 2050	Animal Behavior	1/3
BB 2550	Cell Biology	1/3
BB 2902	Enzymes, Proteins, and Purification	1/6
BB 2903	Anatomy and Physiology	1/6
BB 2904	Ecology, Environment, and Animal Behavior	1/6
BB 2915	Searching for Solutions in Soil: Microbial and Molecular Investigations	1/3
BB 2917	Hunting for Phage	1/3
BB 2920	Genetics	1/3
BB 2950	Molecular Biology	1/3
BB 3003	Medical Microbiology: Plagues of the Modern World, a Case Study Approach	1/3
BB 3010/BCB 3010	Simulation in Biology	1/3
BB 3050	Cancer Biology	1/3
BB 3080	Neurobiology	1/3
BB 3101	Human Anatomy & Physiology: Movement and Communication	1/3
BB 3102	Human Anatomy & Physiology: Transport and Maintenance	1/3
BB 3120	Plant Physiology	1/3
BB 3140	Evolution: Pattern and Process	1/3
BB 3512	Molecular Genetics Lab	1/6
BB 3513	Cell Culture Techniques for Animal Cells	1/6
BB 3515	Physiologic Systems Laboratory	1/3
BB 3517	Fermentation	1/6
BB 3519	Protein Purification	1/6
BB 3521	Microscopy	1/6
BB 3525	Plant Physiology	1/6
BB 3526	Phage Hunters: the Analysis	1/6
BB 3527	Molecular Biology and Genetic Engineering: Approaches and Applications	1/3
BB 3530	Immunotherapies: The Next Generation of Pharmaceuticals	1/3
BB 3570	Cell Culture Models for Tissue Regeneration	1/3
BB 3620	Developmental Biology	1/3
BB 3920	Immunology	1/3
BB 4150	Environmental Change: Problems and Approaches	1/3
BB 4170/CH 4170	Experimental Genetic Engineering	1/3
BB 4190/CH 4190	Regulation of Gene Expression	1/3
BB 4260	Synthetic Biology	1/3
BB 4801/BCB 4001	Bioinformatics	1/3
BB 4900	Capstone Experience in Biology and Biotechnology	1/3

Related courses (Minimum 3/3 Units)

Students choose 3/3 units from all BB 3000 level, BCB 4002 (or CS 4802), BCB 4003 (or CS 4803), BCB 4004 (or MA 4603), CE 3059, CH 2330, CH 3510, CH 4110, CH 4120, CH 4130, CH 4140, CH 4160 or CHE 3301).

3000 Level Biology and Biotechnology Courses

Item #	Title	Units
BB 3003	Medical Microbiology: Plagues of the Modern World, a Case Study Approach	1/3
BB 3010/BCB 3010	Simulation in Biology	1/3
BB 3050	Cancer Biology	1/3
BB 3080	Neurobiology	1/3
BB 3101	Human Anatomy & Physiology: Movement and Communication	1/3
BB 3102	Human Anatomy & Physiology: Transport and Maintenance	1/3
BB 3120	Plant Physiology	1/3
BB 3140	Evolution: Pattern and Process	1/3
BB 3512	Molecular Genetics Lab	1/6
BB 3513	Cell Culture Techniques for Animal Cells	1/6
BB 3515	Physiologic Systems Laboratory	1/3
BB 3517	Fermentation	1/6
BB 3519	Protein Purification	1/6
BB 3521	Microscopy	1/6
BB 3525	Plant Physiology	1/6
BB 3526	Phage Hunters: the Analysis	1/6
BB 3527	Molecular Biology and Genetic Engineering: Approaches and Applications	1/3
BB 3530	Immunotherapies: The Next Generation of Pharmaceuticals	1/3
BB 3570	Cell Culture Models for Tissue Regeneration	1/3
BB 3620	Developmental Biology	1/3
BB 3920	Immunology	1/3

Additional Related Courses

Item #	Title	Units
BCB 4002/CS 4802	Biovisualization	1/3
BCB 4003/CS 4803	Biological and Biomedical Database Mining	1/3
BCB 4004/MA 4603	Statistical Methods in Genetics and Bioinformatics	1/3
CE 3059	Environmental Engineering	1/3
CH 2330	Organic Chemistry III	1/3
CH 3510	Chemical Thermodynamics	1/3
CH 4110	Protein Structure and Function	1/3
CH 4120	Lipids and Biomembrane Functions	1/3
CH 4130	Nucleic Acids and Bioinformation	1/3
CH 4140	Metabolism and Disease	1/3
CH 4160	Membrane Biophysics	1/3
CHE 3301	Introduction to Biological Engineering	1/3

MQP (3/3 Units)

The Three Major Divisions of Biology

1. Cellular and Molecular

Item #	Title	Units
BB 1035	Biotechnology	1/3
BB 2003	Fundamentals of Microbiology	1/3
BB 2550	Cell Biology	1/3
BB 2920	Genetics	1/3
BB 2950	Molecular Biology	1/3
BB 3003	Medical Microbiology: Plagues of the Modern World, a Case Study Approach	1/3
BB 3050	Cancer Biology	1/3
BB 4190/CH 4190	Regulation of Gene Expression	1/3
BB 4260	Synthetic Biology	1/3

2. Biology of the Organism

Item #	Title	Units
BB 1025	Human Biology	1/3
BB 3080	Neurobiology	1/3
BB 3101	Human Anatomy & Physiology: Movement and Communication	1/3
BB 3102	Human Anatomy & Physiology: Transport and Maintenance	1/3
BB 3120	Plant Physiology	1/3
BB 3620	Developmental Biology	1/3
BB 3920	Immunology	1/3

3. Organisms in their Environment

Item #	Title	Units
BB 1045	Biodiversity	1/3
BB 2030	Plant Diversity	1/3
BB 2040	Principles of Ecology	1/3
BB 2050	Animal Behavior	1/3
BB 3140	Evolution: Pattern and Process	1/3

Undergraduate Research Projects

The biology and biotechnology facilities offer an exceptional learning opportunity since research in an active laboratory group is the principal teaching tool. Tools for modern biochemistry, molecular biology, tissue culture, fermentation, ecology, microscopy and computer integration are all available to undergraduates.

In conjunction with the faculty, students who wish to expand their educational opportunities pursue many off-campus projects each year. Investigations may take place at institutions that have traditionally worked with WPI, such as the University of Massachusetts Medical School and Tufts Cummings School of Veterinary Medicine. The department also has established links with several companies that provide opportunities for project work and summer employment in applied biology and biotechnology.

Undergraduate research projects may be proposed by individual students or groups of students, or may be selected from on-going research activities of the faculty. The departmental faculty must be consulted for approval of a project before student work begins.

Biology Minor

Degree Type

Minor

Rather than trying to cover the entire field of biology, the minor in biology has been designed to allow the student to survey a few areas of biology (e.g. ecology and genetics) or to select a specific area of focus (e.g. cell biology) for the minor. In either case, students will complete three courses at the 1000 and 2000 level to provide broad foundational knowledge, two laboratory modules, and two 3000/4000 level courses for advanced study, including a 4000 level course of the student's choosing. Students should choose their foundational courses carefully so that they provide recommended background for upper level courses they plan to take. As with all minors, 1 unit of this work may be double counted toward meeting another degree requirement, while a minimum of 1 unit of the work must be unique to the minor. The specific requirements for the minor are as follows:

Program Requirements for the Biology Minor:

1000 Level Biology and Biotechnology (Minimum 1/3 Units)

BB 1000, BB 1001, BB 1002, BB/BCB 1003 cannot be used to fulfill this requirement.

Item #	Title	Units
BB 1001	Introduction to Biology	1/3
BB 1002	Environmental Biology	1/3
BB 1003/BCB 1003	Exploring Bioinformatics and Computational Biology	1/3
BB 1025	Human Biology	1/3
BB 1035	Biotechnology	1/3
BB 1045	Biodiversity	1/3

2000 Level Biology and Biotechnology Courses (Minimum 2/3 Units)

Item #	Title	Units
BB 2002	Microbiology	1/3
BB 2003	Fundamentals of Microbiology	1/3
BB 2030	Plant Diversity	1/3
BB 2040	Principles of Ecology	1/3
BB 2050	Animal Behavior	1/3
BB 2550	Cell Biology	1/3
BB 2902	Enzymes, Proteins, and Purification	1/6
BB 2903	Anatomy and Physiology	1/6
BB 2904	Ecology, Environment, and Animal Behavior	1/6
BB 2915	Searching for Solutions in Soil: Microbial and Molecular Investigations	1/3
BB 2917	Hunting for Phage	1/3
BB 2920	Genetics	1/3
BB 2950	Molecular Biology	1/3

Biology and Biotechnology Laboratory Courses (Minimum 1/3 Credits)

At least one of the BB laboratory courses must be at the 2000-level.

3000/4000 Level Biology and Biotechnology Courses (Minimum 1/3 Unit)

Item #	Title	Units
BB 3003	Medical Microbiology: Plagues of the Modern World, a Case Study Approach	1/3
BB 3010/BCB 3010	Simulation in Biology	1/3
BB 3050	Cancer Biology	1/3
BB 3080	Neurobiology	1/3
BB 3101	Human Anatomy & Physiology: Movement and Communication	1/3
BB 3102	Human Anatomy & Physiology: Transport and Maintenance	1/3
BB 3120	Plant Physiology	1/3
BB 3140	Evolution: Pattern and Process	1/3
BB 3512	Molecular Genetics Lab	1/6
BB 3513	Cell Culture Techniques for Animal Cells	1/6
BB 3515	Physiologic Systems Laboratory	1/3
BB 3517	Fermentation	1/6
BB 3519	Protein Purification	1/6
BB 3521	Microscopy	1/6
BB 3525	Plant Physiology	1/6
BB 3526	Phage Hunters: the Analysis	1/6
BB 3527	Molecular Biology and Genetic Engineering: Approaches and Applications	1/3
BB 3530	Immunotherapies: The Next Generation of Pharmaceuticals	1/3
BB 3570	Cell Culture Models for Tissue Regeneration	1/3
BB 3620	Developmental Biology	1/3
BB 3920	Immunology	1/3
BB 4150	Environmental Change: Problems and Approaches	1/3
BB 4170/CH 4170	Experimental Genetic Engineering	1/3
BB 4190/CH 4190	Regulation of Gene Expression	1/3
BB 4260	Synthetic Biology	1/3
BB 4801/BCB 4001	Bioinformatics	1/3
BB 4900	Capstone Experience in Biology and Biotechnology	1/3

4000 Biology and Biotechnology Courses (Minimum 1/3 Units)

Item #	Title	Units
BB 4150	Environmental Change: Problems and Approaches	1/3
BB 4170/CH 4170	Experimental Genetic Engineering	1/3
BB 4190/CH 4190	Regulation of Gene Expression	1/3
BB 4260	Synthetic Biology	1/3
BB 4801/BCB 4001	Bioinformatics	1/3
BB 4900	Capstone Experience in Biology and Biotechnology	1/3

Chemistry and Biochemistry

A. Mattson, INTERIM HEAD

U. Kumar, ASSOCIATE HEAD

PROFESSORS: J. M. Argüello, B. Bursten, S.C. Burdette, R. Dempski, J. P. Dittami, A. Gericke, A. Mattson, S. Scarlata, K. N. Wobbe

PROFESSOR OF TEACHING: D. Heilman

TEACHING PROFESSOR: D.R. Brodeur, C. Lambert, U. Kumar

ASSOCIATE PROFESSORS: R. Grimm, G. Kaminski, J. C. MacDonald

ASSISTANT PROFESSORS: C. Olsen, P. Z. Musacchio

ASSISTANT TEACHING PROFESSOR: I. Mardilovich, R. Orduna Picon

EMERITUS PROFESSORS: N. Kildahl, J. Pavlik, A. Seala, S. Weininger

Mission Statement

Through dynamic and innovative classroom instruction and exciting cutting edge research programs, the Department of Chemistry and Biochemistry strives to provide students with both a broad understanding of the fundamentals of the chemical sciences and an opportunity to create new chemical and biochemical knowledge through original research. We aspire to produce graduates who will enter their scientific careers with the confidence and competence to lead the advance of chemistry and biochemistry in the 21st century.

Program Educational Objectives

The Department of Chemistry and Biochemistry will graduate outstanding professionals possessing fundamental knowledge of the chemical sciences. Graduates will be able to apply this knowledge to the solution of problems in chemistry and biochemistry for the advancement of knowledge in these fields and the improvement of the standard of living of all humanity.

Program Outcomes

Students graduating with a major in Chemistry or Biochemistry will be able to demonstrate an ability to:

- perform accurate and precise quantitative measurements
- use and understand modern instruments, particularly NMR, IR, and UV-vis spectrometers, chromatographs, electrochemical instruments, and lab computers
- keep legible and complete experimental records
- analyze data statistically and assess reliability of results
- anticipate, recognize, and respond properly to hazards of chemical manipulations
- interpret experimental results and draw reasonable conclusions
- plan and execute experiments through use of the literature
- design experiments
- communicate effectively through oral and written reports
- critically assess their work for reasonableness and self-consistency
- adhere to high ethical standards
- learn independently

Biochemistry Major

Degree Type
Bachelor of Science

In addition to the WPI requirements applicable to all students (see page 7), students wishing to graduate with a degree in biochemistry must meet the distribution requirements detailed below.

Program Distribution Requirements for the Biochemistry B.S.

Mathematics and Physics Requirement (Minimum 6/3 Units)

Students must complete 6/3 units (18 credits) of mathematics and physics. The mathematics in MA 1021-MA 1024 or the equivalent is recommended. The physics in PH 1110-PH 1120 or equivalent is recommended.

Recommended Courses:

Item #	Title	Units
MA 1021	Calculus I	1/3
MA 1022	Calculus II	1/3
MA 1023	Calculus III	1/3
MA 1024	Calculus IV	1/3
PH 1110	General Physics—Mechanics	1/3
PH 1120	General Physics—Electricity and Magnetism	1/3

Chemistry and Biochemistry Requirement (Minimum 13/3 Units)

These 13/3 (39 credits) units must include one unit of organic, 4/3 units of biochemistry, and 1/3 unit each of physical (3000 level or higher) and inorganic chemistry (3000 level or higher).

Organic Chemistry (1 unit)

Item #	Title	Units
BB 2920	Genetics	1/3
CH 2310	Organic Chemistry I	1/3
CH 2320	Organic Chemistry II	1/3
CH 2330	Organic Chemistry III	1/3
CH 2360	Organic Laboratory	1/3
CH 2660	Organic Synthesis and Analysis Laboratory	1/3
CH 3310	Advanced Organic Chemistry	1/3
CH 4330	Organic Synthesis	1/3
CH 536	Theory and Applications of NMR Spectroscopy	1/3
CH 538	Medicinal Chemistry	1/3

Biochemistry (4/3 units)

Item #	Title	Units
BB 4170/CH 4170	Experimental Genetic Engineering	1/3
BB 4190/CH 4190	Regulation of Gene Expression	1/3
CH 4110	Protein Structure and Function	1/3
CH 4120	Lipids and Biomembrane Functions	1/3
CH 4130	Nucleic Acids and Bioinformation	1/3
CH 4140	Metabolism and Disease	1/3
CH 4150	Enzymology and Protein Characterization Laboratory	1/3
CH 4160	Membrane Biophysics	1/3

Physical Chemistry at the 3000 level or higher (1/3 unit)

Item #	Title	Units
CH 3510	Chemical Thermodynamics	1/3
CH 3530	Quantum Chemistry	1/3
CH 3550	Chemical Dynamics	1/3

Biology (Minimum 4/3 units)

These 4/3 units must include 1/3 unit of cell biology, 1/3 unit of genetics, and 1/3 unit of advanced work (3000 level or higher).

1000 Level Biology and Biotechnology Courses

Item #	Title	Units
BB 1001	Introduction to Biology	1/3
BB 1002	Environmental Biology	1/3
BB 1003/BCB 1003	Exploring Bioinformatics and Computational Biology	1/3
BB 1025	Human Biology	1/3
BB 1035	Biotechnology	1/3
BB 1045	Biodiversity	1/3

2000 Level Biology and Biotechnology Courses

Item #	Title	Units
BB 2002	Microbiology	1/3
BB 2003	Fundamentals of Microbiology	1/3
BB 2030	Plant Diversity	1/3
BB 2040	Principles of Ecology	1/3
BB 2050	Animal Behavior	1/3
BB 2550	Cell Biology	1/3
BB 2902	Enzymes, Proteins, and Purification	1/6
BB 2903	Anatomy and Physiology	1/6
BB 2904	Ecology, Environment, and Animal Behavior	1/6
BB 2915	Searching for Solutions in Soil: Microbial and Molecular Investigations	1/3
BB 2917	Hunting for Phage	1/3
BB 2920	Genetics	1/3
BB 2950	Molecular Biology	1/3

3000 Level Biology and Biotechnology Courses

Item #	Title	Units
BB 3003	Medical Microbiology: Plagues of the Modern World, a Case Study Approach	1/3
BB 3010/BCB 3010	Simulation in Biology	1/3
BB 3050	Cancer Biology	1/3
BB 3080	Neurobiology	1/3
BB 3101	Human Anatomy & Physiology: Movement and Communication	1/3
BB 3102	Human Anatomy & Physiology: Transport and Maintenance	1/3
BB 3120	Plant Physiology	1/3
BB 3140	Evolution: Pattern and Process	1/3
BB 3512	Molecular Genetics Lab	1/6
BB 3513	Cell Culture Techniques for Animal Cells	1/6
BB 3515	Physiologic Systems Laboratory	1/3
BB 3517	Fermentation	1/6
BB 3519	Protein Purification	1/6
BB 3521	Microscopy	1/6
BB 3525	Plant Physiology	1/6
BB 3526	Phage Hunters: the Analysis	1/6
BB 3527	Molecular Biology and Genetic Engineering: Approaches and Applications	1/3
BB 3530	Immunotherapies: The Next Generation of Pharmaceuticals	1/3
BB 3570	Cell Culture Models for Tissue Regeneration	1/3
BB 3620	Developmental Biology	1/3
BB 3920	Immunology	1/3

4000 Level Biology and Biotechnology Courses

Item #	Title	Units
BB 4150	Environmental Change: Problems and Approaches	1/3
BB 4170/CH 4170	Experimental Genetic Engineering	1/3
BB 4190/CH 4190	Regulation of Gene Expression	1/3
BB 4260	Synthetic Biology	1/3
BB 4801/BCB 4001	Bioinformatics	1/3
BB 4900	Capstone Experience in Biology and Biotechnology	1/3

Chemistry and Biochemistry/Biology Laboratory (Minimum 4/3 Units)

This unit must include a minimum of 2/3 units of Chemistry and Biochemistry labs, of which 1/3 unit must be either CH 4150 or CH 4170. The remaining 1/3 unit may come from BB or CBC labs. However, counting both CH 4170 and BB 3527 is not allowed.

Chemistry and Biochemistry Labs

Item #	Title	Units
BB 4170/CH 4170	Experimental Genetic Engineering	1/3
CH 2360	Organic Laboratory	1/3
CH 2640	Experimental Chemistry I: Instrumental Analysis	1/3
CH 2650	Modern Physical Chemistry Methods	1/3
CH 2660	Organic Synthesis and Analysis Laboratory	1/3
CH 2670	Investigation of Coordination Complexes Through Inquiry	1/3
CH 4150	Enzymology and Protein Characterization Laboratory	1/3

Biology and Biochemistry Labs

Item #	Title	Units
BB 3512	Molecular Genetics Lab	1/6
BB 3513	Cell Culture Techniques for Animal Cells	1/6
BB 3515	Physiologic Systems Laboratory	1/3
BB 3517	Fermentation	1/6
BB 3519	Protein Purification	1/6
BB 3521	Microscopy	1/6
BB 3526	Phage Hunters: the Analysis	1/6
BB 3527	Molecular Biology and Genetic Engineering: Approaches and Applications	1/3
BB 3530	Immunotherapies: The Next Generation of Pharmaceuticals	1/3
BB 3570	Cell Culture Models for Tissue Regeneration	1/3
BB 4170/CH 4170	Experimental Genetic Engineering	1/3

Other Natural Science or Computer Science (Minimum 1/3 Units)

Any course in the natural sciences (not used to satisfy another requirement) or in computer science may be used to satisfy this requirement.

Major Qualifying Project (Minimum 3/3 Units)

Recommendations for Students

A typical Biochemistry curriculum is given below.

Premedical students should take three terms of Physics, as well as the Organic Chemistry Laboratory (CH 2360), by the end of their third year.
BB 1035 is recommended as the initial course for students who need to strengthen their background in biology. Note that a total of one unit designated Elective in the table must be in Biology.

Students should take 1/3 unit of advanced Biology laboratory (BB 3512, 3518, 3519, 3520 are recommended) at their discretion as to the term; however, this should preferably be done before the MQP is commenced.

Recommended Biochemistry Program

Year	Term A	Term B	Term C	Term D
First	CH 1010 BB 2550 MA	CH 1020 HU MA	CH 1030 BB 2920 MA	CH 1040 HU MA
Second	CH 3510 CH 2640 HU	CH 2310 SS HU	CH 2320 HU PH	CH 2330 HU PH
Third	CH 4110 BB Lab SS	CH 4120 CH 4150 IQP	CH 4130 CH 3410 IQP	CH 4170 CH 4140 IQP
Fourth	Elective MQP Elective	Elective MQP Elective	CH 4160 MQP Elective	CH 4190 MQP Elective

Program Chart and/or Course Flow Chart

Year	Term A	Term B	Term C	Term D
First	CH 1010 BB 2550 MA	CH 1020 HU MA	CH 1030 BB 2920 MA	CH 1040 HU MA
Second	CH 3510 CH 2640 HU	CH 2310 SS HU	CH 2320 HU PH	CH 2330 HU PH
Third	CH 4110 BB Lab SS	CH 4120 CH 4150 IQP	CH 4130 CH 3410 IQP	CH 4170 CH 4140 IQP
Fourth	Elective MQP Elective	Elective MQP Elective	CH 4160 MQP Elective	CH 4190 MQP Elective

Chemistry Major

Degree Type

Bachelor of Science

Program Distribution Requirements for the Chemistry B.S.

In addition to the WPI requirements applicable to all students (see page 7), students wishing to graduate with a degree in chemistry must meet the distribution requirements detailed below.

Mathematics & Physics (Minimum 7/3 Units)

Students must complete 7/3 units (21 credits) of mathematics and physics. Math courses must include differential and integral calculus (Calculus I & Calculus II or equivalent). 2/3 unit must be completed in physics (PH1110 & PH1120 or PH1111 & PH 1112 or equivalent is recommended). One additional unit (9 credits) can be completed in any other math or physics courses.

Mathematics

1000 Level Courses

Item #	Title	Units
MA 1020	Calculus I with Preliminary Topics	1/3
MA 1021	Calculus I	1/3
MA 1022	Calculus II	1/3
MA 1023	Calculus III	1/3
MA 1024	Calculus IV	1/3
MA 1033	Theoretical Calculus III	1/3
MA 1034	Theoretical Calculus IV	1/3
MA 1120	Calculus II (Semester Version)	1/3
MA 1801	Denksport	1/12
MA 1971	Bridge to Higher Mathematics	1/3

2000 Level Courses

Item #	Title	Units
CS 2022/MA 2201	Discrete Mathematics	1/3
MA 2051	Ordinary Differential Equations	1/3
MA 2071	Matrices and Linear Algebra I	1/3
MA 2072	Accelerated Matrices and Linear Algebra I	1/3
MA 2073	Matrices and Linear Algebra II	1/3
MA 2210	Mathematical Methods in Decision Making	1/3
MA 2211	Theory of Interest I	1/3
MA 2212	Theory of Interest II	1/3
MA 2251	Vector and Tensor Calculus	1/3
MA 2271	Graph Theory	1/3
MA 2273	Combinatorics	1/3
MA 2431	Mathematical Modeling with Ordinary Differential Equations	1/3
MA 2610	Applied Statistics for the Life Sciences	1/3
MA 2611	Applied Statistics I	1/3
MA 2612	Applied Statistics II	1/3
MA 2621	Probability for Applications	1/3
MA 2631	Probability Theory	1/3

3000 Level Courses

Item #	Title	Units
CS 4032/MA 3257	Numerical Methods for Linear and Nonlinear Systems	1/3
CS 4033/MA 3457	Numerical Methods for Calculus and Differential Equations	1/3
MA 3212	Actuarial Mathematics I	1/3
MA 3213	Actuarial Mathematics II	1/3
MA 3231	Linear Programming	1/3
MA 3233	Discrete Optimization	1/3
MA 3457/CS 4033	Numerical Methods for Calculus and Differential Equations	1/3
MA 3471	Advanced Ordinary Differential Equations	1/3
MA 3475	Calculus of Variations	1/3
MA 3627	Introduction to the Design and Analysis of Experiments	1/3
MA 3631	Mathematical Statistics	1/3
MA 3823	Group Theory	1/3
MA 3825	Rings and Fields	1/3
MA 3831	Principles of Real Analysis I	1/3
MA 3832	Principles of Real Analysis II	1/3

4000 Level Courses

Item #	Title	Units
BCB 4004/MA 4603	Statistical Methods in Genetics and Bioinformatics	1/3
DS 4635/MA 4635	Data Analytics and Statistical Learning	1/3
MA 4213	Loss Models I - Risk Theory	1/3
MA 4214	Loss Models II - Survival Models	1/3
MA 4216	Actuarial Seminar	
MA 4222	Top Algorithms in Applied Mathematics	1/3
MA 4235	Mathematical Optimization	1/3
MA 4237	Probabilistic Methods in Operations Research	1/3
MA 4291	Applied Complex Variables	1/3
MA 4411	Numerical Analysis of Differential Equations	1/3
MA 4451	Boundary Value Problems	1/3
MA 4473	Partial Differential Equations	1/3
MA 4631	Probability and Mathematical Statistics I	1/3
MA 4632	Probability and Mathematical Statistics II	1/3
MA 4891	Topics in Mathematics	1/3
MA 4892	Topics in Actuarial Mathematics	1/3
MA 4895	Differential Geometry	1/3

Physics

1000 Level Courses

Item #	Title	Units
PH 1110	General Physics—Mechanics	1/3
PH 1111	Principles of Physics—Mechanics	1/3
PH 1120	General Physics—Electricity and Magnetism	1/3
PH 1121	Principles of Physics—Electricity and Magnetism	1/3
PH 1130	Modern Physics	1/3
PH 1140	Oscillations and Waves	1/3
PH 1150	Introductory Physics of Living Systems	1/3

2000 Level Courses

Item #	Title	Units
PH 2101	Principles of Thermodynamics	1/3
PH 2201	Intermediate Mechanics I	1/3
PH 2202	Intermediate Mechanics II	1/3
PH 2301	Electromagnetic Fields	1/3
PH 2501	Photonics	1/3
PH 2502	Lasers	1/3
PH 2510	Atomic Force Microscopy	1/3
PH 2520	Introduction to Astrophysics	1/3
PH 2540	Solar Systems	1/3
PH 2550/AE 2550	Atmospheric and Space Environments	1/3
PH 2601	Photonics Laboratory	1/3
PH 2651	Intermediate Physics Laboratory	1/3

3000 Level Courses

Item #	Title	Units
PH 3206	Statistical Physics	1/3
PH 3301	Electromagnetic Theory	1/3
PH 3401	Quantum Mechanics I	1/3
PH 3402	Quantum Mechanics II	1/3
PH 3501	Relativity	1/3
PH 3502	Solid State Physics	1/3
PH 3503	Nuclear Physics	1/3
PH 3504	Optics	1/3

4000 Level Courses

Item #	Title	Units
PH 4201/PH 511	Advanced Classical Mechanics	1/3

Chemistry (Minimum 12/3 Units)

Students must complete 12/3 units (36 credits) of chemistry. These courses must be above the level of general chemistry (2000 of higher).

4 units must include courses in experimental chemistry (either 4/3 unit or 3/3 unit), inorganic chemistry (1/3 unit), organic chemistry (3/3 unit), physical chemistry (3/3 unit), and biochemistry (either 1/3 unit or 2/3 unit, depending on the number of experimental chemistry courses taken). At least 2/3 units must be at or higher than the 4000 level.

Students cannot receive credit for both CH2360 and CH2600.

Experimental Chemistry (Either 3/3 or 4/3 Units)

Item #	Title	Units
CH 2360	Organic Laboratory	1/3
CH 2640	Experimental Chemistry I: Instrumental Analysis	1/3
CH 2650	Modern Physical Chemistry Methods	1/3
CH 2660	Organic Synthesis and Analysis Laboratory	1/3
CH 2670	Investigation of Coordination Complexes Through Inquiry	1/3

Physical Chemistry (1/3 Units)

Item #	Title	Units
CH 3510	Chemical Thermodynamics	1/3
CH 3530	Quantum Chemistry	1/3
CH 3550	Chemical Dynamics	1/3
CH 4520	Chemical Statistical Mechanics	1/3
CHE 554/CH 554	Molecular Modeling	1/3

Inorganic Chemistry (1/3 Units)

Item #	Title	Units
CH 3410	Structure, Bonding, and Reactivity in Inorganic Chemistry	1/3
CH 4420	Principles and Applications of Group Theory in Chemistry	1/3

Organic Chemistry (1/3 Units)

Item #	Title	Units
CH 2310	Organic Chemistry I	1/3
CH 2320	Organic Chemistry II	1/3
CH 2330	Organic Chemistry III	1/3
CH 2360	Organic Laboratory	1/3
CH 3310	Advanced Organic Chemistry	1/3
CH 4330	Organic Synthesis	1/3
CH 516	Chemical Spectroscopy	0/1
CH 536	Theory and Applications of NMR Spectroscopy	1/3
CH 538	Medicinal Chemistry	1/3

Biochemistry (Either 1/3 or 2/3 Units)

Item #	Title	Units
BB 4170/CH 4170	Experimental Genetic Engineering	1/3
BB 4190/CH 4190	Regulation of Gene Expression	1/3
CH 4110	Protein Structure and Function	1/3
CH 4120	Lipids and Biomembrane Functions	1/3
CH 4130	Nucleic Acids and Bioinformation	1/3
CH 4140	Metabolism and Disease	1/3
CH 4150	Enzymology and Protein Characterization Laboratory	1/3
CH 4160	Membrane Biophysics	1/3

Additional Science/Engineering requirements (11/3 units)

Students must complete an additional 11/3 units (33 credits) distributed among the MQP, the natural and physical sciences, computer science, mathematics, and engineering (and including general chemistry, CH 1010-1040).

Students cannot receive credit for both CH2360 and CH2600.

Recommendations for Students

Chemistry utilizes many of the concepts of physics and the tools of mathematics. Students should acquire a background in these subjects early in their programs. The material addressed in MA 1021 through MA 1024 is recommended for all chemistry majors. Students will also benefit from knowledge of differential equations, as discussed in MA 2051. Physics background should include mechanics, and electricity and magnetism. Either the PH 1110-1120 or the PH 1111-1121 sequence is recommended. Students seeking more depth in physics are advised to pursue PH 1130 and PH 1140.

Students seeking ACS certification (see below) should plan to study calculus through introductory multivariable calculus (MA 1021-1024), differential equations (MA 2051) and linear algebra (MA 2071), and should take a minimum of two courses in physics (for example, PH 1111 and PH 1121).

American Chemical Society Approval and Certification

The Department of Chemistry and Biochemistry has an American Chemical Society (ACS) approved program. Thus graduates who complete programs satisfying the ACS recommendations have their degrees certified to the society by the department. Accordingly, students can earn an “ACS-Certified Degree in Chemistry” or an “ACS-Certified Degree in Chemistry with a Biochemistry Option.”

ACS-Certified graduates are eligible for immediate membership in the ACS and thus are able to secure the benefits of membership, which include helpful services such as finding employment.

ACS-Certified Degree in Chemistry

The above sequence of courses, recommended to provide fundamental background in chemistry, will result in an ACS-certified degree in chemistry. Specialization in particular areas of interest is best accomplished via additional courses and projects, generally taken in the third and fourth years.

ACS-Certified Degree in Chemistry with a Biochemistry Option

Students seeking the ACS-Certified Degree with Biochemistry Option must complete the following work in addition to those requirements noted above for an ACS-Certified Degree in Chemistry.

- 1/3 unit of biology which contains cell biology, microbiology or genetics.
- 2/3 unit of biochemistry that has organic chemistry as a prerequisite.
- 1/3 unit of a laboratory in biochemical methods.
- Research in biochemistry culminating in a comprehensive written report is highly recommended.

Project Activity

A student undertaking a Major Qualifying Project in chemistry and biochemistry chooses a faculty advisor in the department with whom to work. This choice is normally made because the student is interested in the research program directed by the faculty member, and wants to become a part of this activity. The student is given a research problem to work on for a minimum of 20 hours a week for 3 terms. Although most MQP projects in chemistry and biochemistry are individual student efforts, team projects involving up to 3 students are occasionally available, depending on the faculty member concerned. The project culminates in a formal written MQP report and a poster session presentation to the department faculty and students. MQP projects in chemistry and biochemistry require a substantial effort from the student in both the laboratory and writing phases. Many projects result in professional publications and/or presentations at professional meetings. The department offers a variety of areas of specialization (see AREAS OF SPECIALIZATION IN CHEMISTRY AND BIOCHEMISTRY below) in which Major Qualifying Projects may be carried out.

Some students, particularly those in biochemistry, choose to do their MQPs at off-campus laboratories. Biochemistry projects have recently been completed at the University of Massachusetts Medical Center and Tufts University School of Veterinary Medicine.

Areas of Specialization in Chemistry and Biochemistry

Computational Chemistry and Molecular Modeling
Gene Regulation
Homogeneous Catalysis
Ion Transport
Materials
Medicinal Chemistry
Membrane Proteins
Membrane Signaling Processes
Molecular Spectroscopy
Nanoscale Design
Natural Products Synthesis
Animal-Virus Biochemistry
Photochemistry
Photophysics
Sensors
Supramolecular Chemistry

Project Activity

A student undertaking a Major Qualifying Project in chemistry and biochemistry chooses a faculty advisor in the department with whom to work. This choice is normally made because the student is interested in the research program directed by the faculty member, and wants to become a part of this activity. The student is given a research problem to work on for a minimum of 20 hours a week for 3 terms. Although most MQP projects in chemistry and biochemistry are individual student efforts, team projects involving up to 3 students are occasionally available, depending on the faculty member concerned. The project culminates in a formal written MQP report and a poster session presentation to the department faculty and students. MQP projects in chemistry and biochemistry require a substantial effort from the student in both the laboratory and writing phases. Many projects result in professional publications and/or presentations at professional meetings. The department offers a variety of areas of specialization (see AREAS OF SPECIALIZATION IN CHEMISTRY AND BIOCHEMISTRY below) in which Major Qualifying Projects may be carried out.

Some students, particularly those in biochemistry, choose to do their MQPs at off-campus laboratories. Biochemistry projects have recently been completed at the University of Massachusetts Medical Center and Tufts University School of Veterinary Medicine.

Areas of Specialization in Chemistry and Biochemistry

Computational Chemistry and Molecular Modeling
Gene Regulation
Homogeneous Catalysis
Ion Transport
Materials
Medicinal Chemistry
Membrane Proteins
Membrane Signaling Processes
Molecular Spectroscopy
Nanoscale Design
Natural Products Synthesis
Animal-Virus Biochemistry
Photochemistry
Photophysics
Sensors
Supramolecular Chemistry

Program Chart and/or Course Flow Chart

Year	Term A	Term B	Term C	Term D
First	CH 1010	CH 1020	CH 1030	CH 1040
Second	CH 2640 (lab) CH 3510 (phys)	CH 2650 (lab) CH 2310 (org)	CH 2660 (lab) CH 2320 (org)	CH 2670 (lab) CH 2330 (org)
Third		CH 3550 (phys)	CH 3410 (inorg) CH 3530 (phys)	
Fourth	CH 4110 (biochem)			CH 4420 (inorg)

Biochemistry Minor

Degree Type
Minor

A biochemistry minor allows students to develop real depth of understanding in biochemistry. The minor can include laboratory work, or be entirely classroom based. As biochemistry is a science that utilizes fundamentals from both chemistry and biology, courses from both areas are included. Some knowledge of organic chemistry is required to fully understand biochemistry.

Two units of study are required for the biochemistry minor as follows (note that in accordance with Institutional rules, one full unit, including the capstone, must be independent of distribution requirements for the major). Courses may count in only one area.

Majors in chemistry may not receive a biochemistry minor.

Program Distribution Requirements for the Biochemistry Minor

Organic Chemistry Requirement (Minimum 1/3 Unit)

Students are required to choose 1/3 unit (3 credits) from the courses listed below.

Item #	Title	Units
BB 2920	Genetics	1/3
CH 2320	Organic Chemistry II	1/3
CH 2330	Organic Chemistry III	1/3
CH 2360	Organic Laboratory	1/3

Biology Requirement (Minimum 1/3 Unit)

Students are required to choose 1/3 unit (3 credits) focused on cellular or subcellular biology from the courses listed below.

Item #	Title	Units
BB 2550	Cell Biology	1/3
BB 2920	Genetics	1/3
BB 3080	Neurobiology	1/3
BB 3620	Developmental Biology	1/3
BB 3920	Immunology	1/3

Biochemistry Requirements (Minimum 3/3 Unit)

Students are required to choose 3/3 units (9 credits) from the courses listed below.

Item #	Title	Units
BB 4170/CH 4170	Experimental Genetic Engineering	1/3
CH 4110	Protein Structure and Function	1/3
CH 4120	Lipids and Biomembrane Functions	1/3
CH 4130	Nucleic Acids and Bioinformation	1/3
CH 4150	Enzymology and Protein Characterization Laboratory	1/3

Capstone to be selected from the following courses (Minimum 1/3 Units)

Item #	Title	Units
BB 4170/CH 4170	Experimental Genetic Engineering	1/3
BB 4190/CH 4190	Regulation of Gene Expression	1/3
CH 4150	Enzymology and Protein Characterization Laboratory	1/3
CH 4160	Membrane Biophysics	1/3

Chemistry Minor

Degree Type
Minor

The Minor in Chemistry is flexible and allows a student to design a minor with the balance between depth and breadth that is appropriate for the student's specific educational and professional objectives. Of the two units of required study, one unit must be at an advanced level (3000/4000), including a 4000 level capstone course. WPI policy for double counting courses to satisfy the requirements for a minor can be found in the Undergraduate Catalog.

Program Distribution Requirements for the Chemistry Minor

Note: A higher level CH course can be used to satisfy the requirement for a lower level course e.g. 2000 for 1000, 3000 /4000 for 2000 etc.

1000-level CH Course (Minimum 1/3 Units)

Item #	Title	Units
CH 1010	Chemical Properties, Bonding, and Forces	1/3
CH 1020	Chemical Reactions	1/3
CH 1030	Kinetics, Equilibrium and Thermodynamics	1/3
CH 1040	Spectroscopy in Organic and Polymer Chemistry	1/3

2000-level CH Courses (Minimum 2/3 Units)

Item #	Title	Units
CH 2310	Organic Chemistry I	1/3
CH 2320	Organic Chemistry II	1/3
CH 2330	Organic Chemistry III	1/3

Selected from CH 2310, CH2320, and CH 2330

3000/4000-level CH Courses (Minimum 2/3 Units)

Item #	Title	Units
BB 4170/CH 4170	Experimental Genetic Engineering	1/3
BB 4190/CH 4190	Regulation of Gene Expression	1/3
CH 3310	Advanced Organic Chemistry	1/3
CH 3410	Structure, Bonding, and Reactivity in Inorganic Chemistry	1/3
CH 3510	Chemical Thermodynamics	1/3
CH 3530	Quantum Chemistry	1/3
CH 3550	Chemical Dynamics	1/3
CH 4110	Protein Structure and Function	1/3
CH 4120	Lipids and Biomembrane Functions	1/3
CH 4130	Nucleic Acids and Bioinformation	1/3
CH 4140	Metabolism and Disease	1/3
CH 4150	Enzymology and Protein Characterization Laboratory	1/3
CH 4160	Membrane Biophysics	1/3
CH 4330	Organic Synthesis	1/3
CH 4420	Principles and Applications of Group Theory in Chemistry	1/3
CH 4520	Chemical Statistical Mechanics	1/3

4000-level CH Courses (Capstone) (Minimum 1/3 Units)

Item #	Title	Units
BB 4170/CH 4170	Experimental Genetic Engineering	1/3
BB 4190/CH 4190	Regulation of Gene Expression	1/3
CH 4110	Protein Structure and Function	1/3
CH 4120	Lipids and Biomembrane Functions	1/3
CH 4130	Nucleic Acids and Bioinformation	1/3
CH 4140	Metabolism and Disease	1/3
CH 4150	Enzymology and Protein Characterization Laboratory	1/3
CH 4160	Membrane Biophysics	1/3
CH 4330	Organic Synthesis	1/3
CH 4420	Principles and Applications of Group Theory in Chemistry	1/3
CH 4520	Chemical Statistical Mechanics	1/3

Two examples of sequences that satisfy the requirements for a CH minor

Many other sequences are possible.

Example Sequence - CH Minor with Breadth

Item #	Title	Units
CH 1020	Chemical Reactions	1/3
CH 2310	Organic Chemistry I	1/3
CH 2320	Organic Chemistry II	1/3
CH 3410	Structure, Bonding, and Reactivity in Inorganic Chemistry	1/3
CH 3510	Chemical Thermodynamics	1/3
CH 4110	Protein Structure and Function	1/3

Example Sequence - CH Minor with Depth in Physical Chemistry

Item #	Title	Units
CH 1020	Chemical Reactions	1/3
CH 3410	Structure, Bonding, and Reactivity in Inorganic Chemistry	1/3
CH 3510	Chemical Thermodynamics	1/3
CH 3530	Quantum Chemistry	1/3
CH 3550	Chemical Dynamics	1/3
CH 4520	Chemical Statistical Mechanics	1/3

Concentration in Medicinal Chemistry

Degree Type
Concentration

Medicinal Chemistry is the application of principles of biology and chemistry to the rational design and synthesis of new drugs for treatment of disease. A medicinal chemist applies knowledge of chemistry, biochemistry and physiology to generate solutions to health-related problems.

A concentration in medicinal chemistry is excellent preparation for students interested in entering health related professions, such as the pharmaceutical industry, upon graduation. Possible employment positions are - numerous and expected to increase in the future.

Course Requirements

In order to be eligible to receive the Medicinal Chemistry designation on their transcripts, chemistry majors need to satisfy the following course requirements:

Three biomedically oriented courses selected from the following list must be included in the distribution requirements.

Three courses oriented toward structure, synthesis, or mechanisms selected from the following list must be included in the distribution requirements. (All graduate courses in chemistry are open to undergraduates.)

In addition to the above course requirements, chemistry majors must complete an MQP in the medicinal chemistry area, approved by the Program Coordinator.

Examples of available projects are:

- Synthesis of huperzine analogs. New acetylcholinesterase inhibitors for treatment of Alzheimer's.
- Synthesis of opiate analogs.
- Computer simulations of small molecules and their interactions with proteins.

Click here to view courses

Item #	Title	Units
BB 4170/CH 4170	Experimental Genetic Engineering	1/3
CH 4110	Protein Structure and Function	1/3
CH 4120	Lipids and Biomembrane Functions	1/3
CH 4130	Nucleic Acids and Bioinformation	1/3
CH 4150	Enzymology and Protein Characterization Laboratory	1/3
CH 4330	Organic Synthesis	1/3
CH 516	Chemical Spectroscopy	0/1
CH 536	Theory and Applications of NMR Spectroscopy	1/3
CH 538	Medicinal Chemistry	1/3
CHE 554/CH 554	Molecular Modeling	1/3

Data Science

E. A. RUNDENSTEINER, PROGRAM DIRECTOR

PROFESSORS: E. A. Rundensteiner, C. Ruiz, D. M. Strong, S.A. Zekavat

ASSOCIATE PROFESSORS: M. Y. Eltabakh, L. T. Harrison, X. Kong, K. Lee, Y. Li, X. Liu, R. Paffenroth, A. Trapp, J. Zou

ASSISTANT PROFESSORS: N. Kordzadeh, O. Mangoubi, R. Shraga

TEACHING PROFESSOR: F. Emdad

ASSISTANT TEACHING PROFESSOR: T. Ghoshal, C. K. Ngan

Mission Statement

Data Science prepares WPI undergraduates with the skills to understand, apply and develop models, algorithms and statistical techniques to gather huge amounts of data, draw new insights from it, and formulate appropriate action plans. Through courses and hands-on project work, students in the Data Science program will master foundational and advanced topics, including state-of-the-art data analytic technologies like machine/deep learning, artificial intelligence, and big data. This prepares the student to tackle the most critical data challenges in interdisciplinary teams with diverse perspectives in this increasingly digital world from climate change, self-driving cars, digital healthcare, to social justice. In addition to being a discipline in and of itself, Data Science complements many of the existing undergraduate majors at WPI. Disciplines from the sciences to engineering increasingly grapple with large data sets using computational and statistical techniques and tools.

Students interested in Data Science, both majors and minors, should check with the Data Science program as early as possible in their academic career to develop a plan of study. Students will be assigned a Data Science advisor after completing a major/minor declaration form.

Program Educational Objectives

In support of its goals and mission, the WPI Data Science undergraduate program's educational objectives are to graduate students who will:

- Bring together a community of diverse disciplinary backgrounds and experiential perspectives to promote creative solutions to critical real-world problems and advance knowledge at the cutting edge
- Achieve professional success due to their mastery of Data Science theory and practice
- Conduct impactful research and project work in data science tacking the world's most challenging problems
- Engage in discovery through purpose-driven project-based learning
- Collaborate with partners both internally and externally in interdisciplinary projects
- Become leaders in business, academia, and society due to a broad preparation in data science, computational thinking, mathematics, science & engineering, communication, and social issues
- Pursue lifelong learning and continuing professional development
- Use their understanding of the impact of data science on society for the benefit of humankind

Theme:

"Gather Information, Form Insights, Impact the World"!

Program Outcomes

Students graduating with a Bachelor of Science degree in Data Science:

- Have mastered foundational studies in business, computer science, and mathematical sciences
- Have mastered advanced principles and techniques in at least one of the three disciplines
- Can apply computational and mathematical knowledge to the solution of big data problems
- Can communicate effectively across disciplines both verbally and in writing
- Can locate, read, and interpret primary literature in data science
- Can function effectively as members of an interdisciplinary team
- Have an understanding of accepted standards of ethical and professional behavior
- Have the ability to be a life-long independent learner

Data Science Major

Degree Type

Bachelor of Science

Program Distribution Requirements for the Data Science Major

The distribution requirements for the BS degree in Data Science consists of a series of interdisciplinary courses in Data Science, fundamental courses in Computer Science, Mathematical Sciences, and Business, and a set of more advanced courses selected primarily from the three supporting disciplines: Computer Science, Mathematical Sciences, and/or Business.

Data Science Core Courses (Minimum 3/3 Units)

Students must complete the series of three DS core courses (DS 1010, DS 2010, and DS 3010)

Data Science Core Courses

Item #	Title	Units
DS 1010	Data Science I: Introduction to Data Science	1/3
DS 2010	Data Science II: Modeling and Data Analysis	1/3
DS 3010	Data Science III: Computational Data Intelligence	1/3

Business Foundation Courses (Minimum 2/3 Units)

Business foundation courses must include 1/3 unit in entrepreneurship and innovation (OBC 1010, ETR 1100, MIS 3010, ETR 3633), and 1/3 unit in business analysis (BUS 2080 OR OIE 2081). One course from each group.

Business Foundation Courses

Item #	Title	Units
BUS 2080	Data Analysis for Decision Making	1/3
ETR 1100	Engineering Innovation and Entrepreneurship	1/3
ETR 3633	Entrepreneurial Selling	1/3
MIS 3010	Creating Value Through Innovation	1/3
OBC 1010	Leadership Practice	1/3
OIE 2081	Introduction to Prescriptive Analytics	1/3

Computer Science Foundation (Minimum 3/3 Units)

Computer science foundation courses must include 2/3 units of introductory computer science (CS 1004, 1101, 1102, CS 2102, CS 2103, CS 2119, or CS elective courses with no more than 1/3 unit at the 1000 level) and 1/3 unit of algorithms (CS 2223).

CS elective courses at level of 3000 and above may be substituted for introductory computer science credits.

Computer Science Foundation Courses

Item #	Title	Units
CS 1004	Introduction to Programming for Non-Majors	1/3
CS 1101	Introduction to Program Design	1/3
CS 1102	Accelerated Introduction to Program Design	1/3
CS 2102	Object-Oriented Design Concepts	1/3
CS 2103	Accelerated Object-Oriented Design Concepts	1/3
CS 2119	Application Building with Object-Oriented Concepts	1/3
CS 2223	Algorithms	1/3

Mathematics Foundation (Minimum 5/3 Units)

Mathematics foundation courses must include 2/3 units calculus (MA 1020, MA 1021, MA 1022, MA 1120, or disciplinary elective courses in MA). Students cannot take both MA 1020 and MA 1021 for credit. Students cannot take both MA 1022 and MA 1120 for credits.
2/3 units applied statistics (MA 2611 and MA 2612), and 1/3 unit linear algebra (MA 2071 or MA 2072).

Mathematics disciplinary elective courses may be substituted for introductory calculus credits.

Mathematics Foundation Courses

Item #	Title	Units
MA 1020	Calculus I with Preliminary Topics	1/3
MA 1021	Calculus I	1/3
MA 1022	Calculus II	1/3
MA 1120	Calculus II (Semester Version)	1/3
MA 2071	Matrices and Linear Algebra I	1/3
MA 2072	Accelerated Matrices and Linear Algebra I	1/3
MA 2611	Applied Statistics I	1/3
MA 2612	Applied Statistics II	1/3

Data Privacy and Ethics (Minimum 1/3 Units)

Choose 1/3 unit from following: CS3043, GOV 2313, GOV 2314, GOV 2315, GOV 2320, PY 2713, PY/RE 2731 or RBE 3100.

Data Privacy and Ethics Courses

Item #	Title	Units
CS 3043	Social Implications of Information Processing	1/3
GOV 2313	Intellectual Property Law	1/3
GOV 2314/ID 2314	Cyberlaw and Policy	1/3
GOV 2315	Privacy: Laws, Policy, Technology, and How They Fit Together	1/3
GOV 2320	Constitutional Law: Civil Rights and Liberties	1/3
PY 2713	Bioethics	1/3
PY 2731/RE 2731	Ethics	1/3
RBE 3100	Social Implications of Robotics	1/3

Natural or Engineering Sciences (2/3 Units)

Natural or Engineering Sciences 2/3 units of work chosen in Natural or Engineering Science (courses with prefixes AE, AREN, BB, BME, CHE, CE, CH, ECE, ES, GE, ME, PH or RBE count).

Disciplinary Elective Requirements

Chosen from disciplinary elective courses in CS, MA, or BUS

At least one course must be selected from each of the following categories:

- Data access and management (CS 3431, MIS 3720, CS 4432, CS4433/DS4433)
- Data mining/machine learning (CS 4445, CS 4342)
- Business modeling and prediction (MIS 4084, OIE 4430)

Disciplinary electives must include at least 4/3 units at the 4000 level or above.

Disciplinary Elective Courses in CS

Item #	Title	Units
BCB 4003/CS 4803	Biological and Biomedical Database Mining	1/3
CS 2022/MA 2201	Discrete Mathematics	1/3
CS 2301	Systems Programming for Non-Majors	1/3
CS 2303	Systems Programming Concepts	1/3
CS 3041	Human-Computer Interaction	1/3
CS 3133	Foundations of Computer Science	1/3
CS 3431	Database Systems I	1/3
CS 3733	Software Engineering	1/3
CS 4120	Analysis of Algorithms	1/3
CS 4233	Object-Oriented Analysis and Design	1/3
CS 4241	Webware: Computational Technology for Network Information Systems	1/3
CS 4341	Introduction to Artificial Intelligence	1/3
CS 4342	Machine Learning	1/3
CS 4432	Database Systems II	1/3
CS 4433/DS 4433	Big Data Management and Analytics	1/3
CS 4445	Data Mining and Knowledge Discovery in Databases	1/3
CS 4804	Data Visualization	1/3

Disciplinary Elective Courses in MA

Item #	Title	Units
BCB 4002/CS 4802	Biovisualization	1/3
BCB 4004/MA 4603	Statistical Methods in Genetics and Bioinformatics	1/3
CS 2022/MA 2201	Discrete Mathematics	1/3
CS 4032/MA 3257	Numerical Methods for Linear and Nonlinear Systems	1/3
DS 4635/MA 4635	Data Analytics and Statistical Learning	1/3
MA 1023	Calculus III	1/3
MA 1024	Calculus IV	1/3
MA 1033	Theoretical Calculus III	1/3
MA 1034	Theoretical Calculus IV	1/3
MA 2051	Ordinary Differential Equations	1/3
MA 2073	Matrices and Linear Algebra II	1/3
MA 2210	Mathematical Methods in Decision Making	1/3
MA 2431	Mathematical Modeling with Ordinary Differential Equations	1/3
MA 2621	Probability for Applications	1/3
MA 2631	Probability Theory	1/3
MA 3231	Linear Programming	1/3
MA 3233	Discrete Optimization	1/3
MA 3627	Introduction to the Design and Analysis of Experiments	1/3
MA 3631	Mathematical Statistics	1/3
MA 4213	Loss Models I - Risk Theory	1/3
MA 4214	Loss Models II - Survival Models	1/3
MA 4235	Mathematical Optimization	1/3
MA 4237	Probabilistic Methods in Operations Research	1/3
MA 4631	Probability and Mathematical Statistics I	1/3
MA 4632	Probability and Mathematical Statistics II	1/3

Disciplinary Elective Courses in BU

Item #	Title	Units
MIS 3720	Business Data Management	1/3
MIS 3787	Business Applications of Machine Learning	1/3
MIS 4084	Business Intelligence	1/3
MIS 4720	Systems Analysis and Design	1/3
MIS 4741	User Experience and Design	1/3
MKT 3650	Consumer Behavior	1/3
OIE 3460	Simulation Modeling and Analysis	1/3
OIE 4430	Advanced Prescriptive Analytics: From Data to Impact	1/3

Please note:

Students who are double counting their data privacy and ethics requirements as a social science are required to take an additional free elective to reach the required 135 credits.

Data Science MQP (3/3 Units)

Data Science project (3/3 units) must have a MQP faculty advisor that has a formal collaborative appointment in the Data Science program

Program Chart and/or Course Flow Chart

DATA SCIENCE MAJOR PROGRAM CHART

UNIVERSITY REQUIREMENTS	
Minimum Academic Credit	15 Units
Residency	8 Units
Humanities and Arts	6/3 Units
Interactive Qualifying Project	3/3 Unit
Social Science	2/3 Unit
Physical Education	1/3 Unit
Free Electives	3/3 Unit

MAJOR-SPECIFIC REQUIREMENTS (10 UNITS)	
DS Core Courses*	3/3 Unit
Disciplinary Foundation Courses	10/3 Units
Disciplinary Electives Courses	11/3 Units
DS MQP	3/3 Unit
Data Privacy and Ethics	1/3 Unit
Sciences	2/3 Unit

(*) DS core courses include DS 1010, DS 2010, DS 3010.

DISCIPLINARY FOUNDATION COURSES (10/3 UNITS)

COMPUTER SCIENCE COURSES (3/3 Unit Required)	MATHEMATICS COURSES (5/3 Unit Required)	BUSINESS COURSES (2/3 Unit Required)
Two of CS 1004, CS 1101, CS 1102, CS 2102, CS 2103, CS 2119, or from CS electives below (**) **AND** One of CS 2223	Two of MA 1020, MA 1021, MA 1022, MA 1120, or from MA electives below **AND** Both MA 2611 and MA 2612 **AND** One of MA 2071 or MA 2072	One of BUS 1010, ETR1100, BUS 3010, ETR 3633 **AND** One of BUS 2080 or OIE 2081

(**) At most 1/3 CS unit at the 1000 level.

DISCIPLINARY ELECTIVE COURSES (11/3 UNITS)

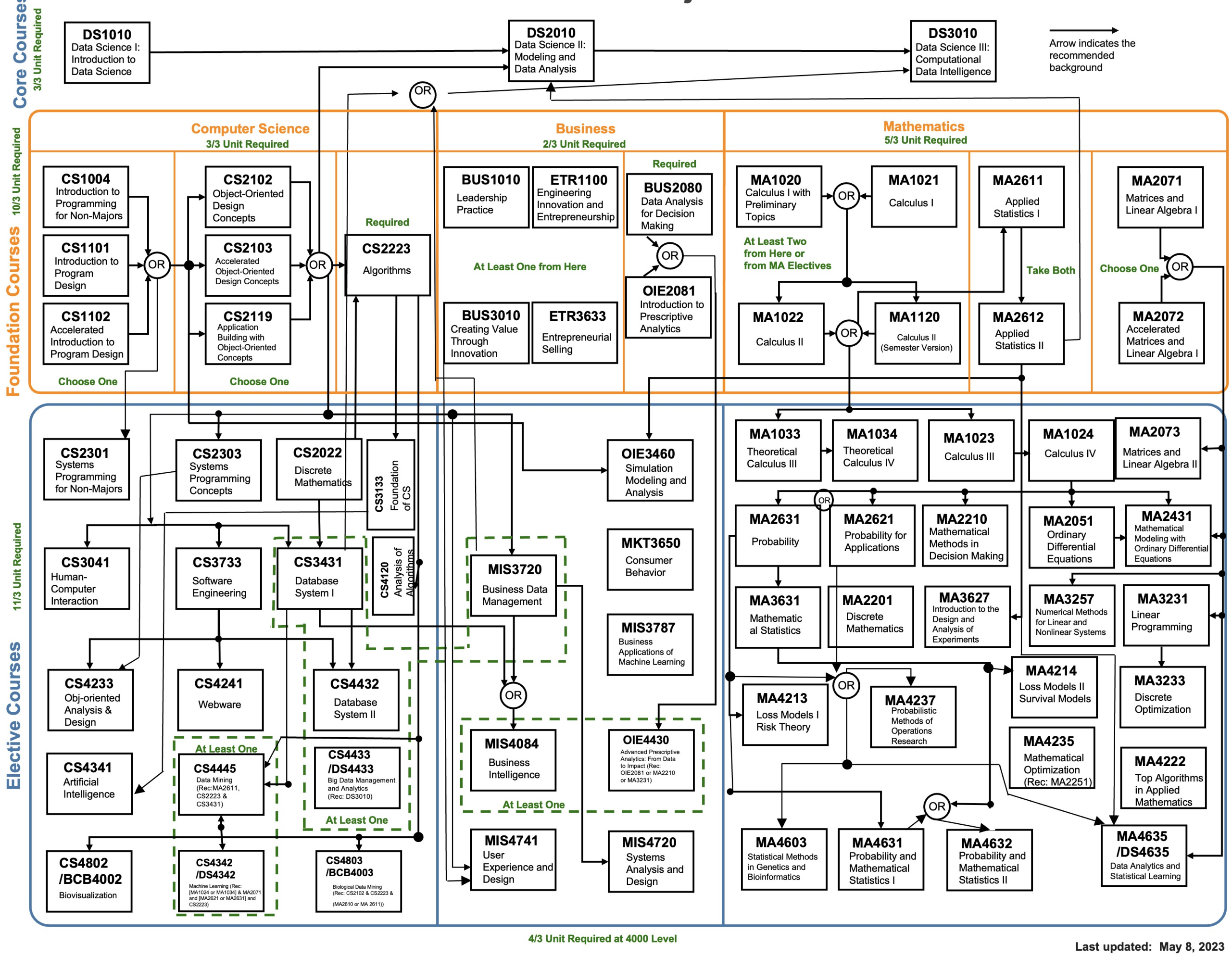
COMPUTER SCIENCE COURSES	MATHEMATICS COURSES	BUSINESS COURSES
CS 2022 CS 2301 CS 2303 CS 3733 CS 3041 CS 3133 +CS 3431 CS 4233 CS 4241 +CS 4341 CS 4120 +CS 4432 +CS 4445 +CS 4342/DS4342 +CS 4804 +CS 4433/DS4433 CS 4802/BCB4002 CS 4803/BCB4003	MA 1023 MA 1024 MA 1033 MA 1034 MA 2051 MA 2073 MA 2201 MA 2210 MA 2431 +MA 2621 +MA 2631 MA 3231 MA 3233 MA 3257 +MA 3627 +MA 3631 MA 4213 MA 4214 MA 4222 MA 4235 MA 4237 +MA 4603 MA 4631 MA 4632 +MA4635/DS4635	+MIS 3720 MKT 3650 OIE 3460 MIS 3787 +MIS 4084 MIS 4720 MIS 4741 +OIE 4430

Electives must include at least one course in each of the categories below:

- Databases (CS 3431, CS 4432, MIS 3720, CS 4433/DS 4433)
- Data mining/machine learning (CS 4445, CS 4342/DS4342)
- Business modeling and prediction (MIS 4084, OIE 4430)

Electives must include at least 4/3 at the 4000 level or above.
Students are encouraged to take electives marked with a "+".

Data Science Courses for Majors Flow Chart



Data Science Minor

Degree Type

Minor

Mission Statement

The Minor in Data Science prepares WPI undergraduates in any major with the skills essential to understand and work with data by applying models, algorithms and statistical techniques to extract, model, analyze and predict data. The minor complements many of the existing undergraduate majors at WPI from sciences to engineering that increasingly must work with large digital data sets using computational and statistical techniques and tools by providing these students with the core competencies of Data Science.

Students interested in the minor should meet with the Data Science minor advisor as early as possible in their academic career to develop a plan of study. They will be assigned a Data Science minor advisor after completing a minor declaration form.

The **Minor in Data Science** will consist of 2 units, all of which must be selected from the list of approved Data Science major courses. These 2 units must be selected to include the following:

Program Distribution Requirements for the Data Science Minor

The Minor in Data Science is open to all undergraduate majors at WPI. Students majoring in Business, Computer Science, or Mathematical Sciences should consult WPI rules on minors for double-counting courses.

Business, Computer Science and Mathematical Sciences (Minimum 3/3 Units)

Three courses, one from each of the three areas (Business, Computer Science, Mathematical Sciences) from the list of disciplinary courses approved for the Data Science major.

Data Science Series (Minimum 2/3 Units)

At least two courses out of the DS series DS 1010, DS 2010, and DS 3010.

Data Science Core Courses

Item #	Title	Units
DS 1010	Data Science I: Introduction to Data Science	1/3
DS 2010	Data Science II: Modeling and Data Analysis	1/3
DS 3010	Data Science III: Computational Data Intelligence	1/3

Advanced Disciplinary Course (Minimum 1/3 Unit)

At least one course at the 3000 level or above selected from the list of disciplinary courses approved for the Data Science major.

*Note that one course satisfies only one of the above requirements.

List of Approved Courses for the Data Science Minor

Data Science Core Courses

Item #	Title	Units
DS 1010	Data Science I: Introduction to Data Science	1/3
DS 2010	Data Science II: Modeling and Data Analysis	1/3
DS 3010	Data Science III: Computational Data Intelligence	1/3

Computer Science Courses

Item #	Title	Units
BCB 4002/CS 4802	Biovisualization	1/3
BCB 4003/CS 4803	Biological and Biomedical Database Mining	1/3
CS 2022/MA 2201	Discrete Mathematics	1/3
CS 2102	Object-Oriented Design Concepts	1/3
CS 2103	Accelerated Object-Oriented Design Concepts	1/3
CS 2119	Application Building with Object-Oriented Concepts	1/3
CS 2223	Algorithms	1/3
CS 2301	Systems Programming for Non-Majors	1/3
CS 2303	Systems Programming Concepts	1/3
CS 3041	Human-Computer Interaction	1/3
CS 3133	Foundations of Computer Science	1/3
CS 3431	Database Systems I	1/3
CS 3733	Software Engineering	1/3
CS 4120	Analysis of Algorithms	1/3
CS 4233	Object-Oriented Analysis and Design	1/3
CS 4241	Webware: Computational Technology for Network Information Systems	1/3
CS 4341	Introduction to Artificial Intelligence	1/3
CS 4342	Machine Learning	1/3
CS 4432	Database Systems II	1/3
CS 4433/DS 4433	Big Data Management and Analytics	1/3
CS 4445	Data Mining and Knowledge Discovery in Databases	1/3

Business Courses

Item #	Title	Units
BUS 2080	Data Analysis for Decision Making	1/3
ETR 3633	Entrepreneurial Selling	1/3
MIS 3010	Creating Value Through Innovation	1/3
MIS 3720	Business Data Management	1/3
MIS 3787	Business Applications of Machine Learning	1/3
MIS 4084	Business Intelligence	1/3
MIS 4720	Systems Analysis and Design	1/3
MIS 4741	User Experience and Design	1/3
MKT 3650	Consumer Behavior	1/3
OIE 2081	Introduction to Prescriptive Analytics	1/3
OIE 3460	Simulation Modeling and Analysis	1/3
OIE 4430	Advanced Prescriptive Analytics: From Data to Impact	1/3

Credit may be earned for both BUS 2080 and OIE 2081

Mathematical Sciences Courses

Item #	Title	Units
BCB 4004/MA 4603	Statistical Methods in Genetics and Bioinformatics	1/3
CS 2022/MA 2201	Discrete Mathematics	1/3
CS 4032/MA 3257	Numerical Methods for Linear and Nonlinear Systems	1/3
DS 4635/MA 4635	Data Analytics and Statistical Learning	1/3
MA 2051	Ordinary Differential Equations	1/3
MA 2071	Matrices and Linear Algebra I	1/3
MA 2072	Accelerated Matrices and Linear Algebra I	1/3
MA 2073	Matrices and Linear Algebra II	1/3
MA 2210	Mathematical Methods in Decision Making	1/3
MA 2431	Mathematical Modeling with Ordinary Differential Equations	1/3
MA 2611	Applied Statistics I	1/3
MA 2612	Applied Statistics II	1/3
MA 2621	Probability for Applications	1/3
MA 2631	Probability Theory	1/3
MA 3231	Linear Programming	1/3
MA 3233	Discrete Optimization	1/3
MA 3627	Introduction to the Design and Analysis of Experiments	1/3
MA 3631	Mathematical Statistics	1/3
MA 4213	Loss Models I - Risk Theory	1/3
MA 4214	Loss Models II - Survival Models	1/3
MA 4235	Mathematical Optimization	1/3
MA 4237	Probabilistic Methods in Operations Research	1/3
MA 4631	Probability and Mathematical Statistics I	1/3
MA 4632	Probability and Mathematical Statistics II	1/3

Credit may not be earned for both MA 2621 and MA 2631.

Notes:

Any graduate course approved for the Data Science graduate program can also be counted towards the Data Science minor. These courses are not repeated here.

At most one course across all requirements may be taken at the 1000-level.

One course satisfies only one of the above requirements.

Computer Science

C. A. SHUE, HEAD

G. T. Heineman, ASSOCIATE HEAD

PROFESSORS: E. Agu, M. Claypool, N. Heffernan, D. Korkin, C. Ruiz, E. A. Rundensteiner, G. N. Sarkozy, C. A. Shue, C. E. Wills

ASSOCIATE PROFESSORS: J. E. Beck, J. Dai, T. Guo, L. T. Harrison, G. T. Heineman, X. Kong, K. Lee, Y. Li, X. Liu, G. M. Smith, E. Solovey, X. Sun, R. J. Walls, J. R. Whitehill

ASSISTANT PROFESSORS: R. Bohrer, F. Murai, D. Reichman, C. D. Roberts, R. Shraga, A. Yousefi, H. Zhan

PROFESSOR OF TEACHING: R. Neamtu

ASSOCIATE TEACHING PROFESSORS: S. Arslan Ay, W. Wong

ASSISTANT TEACHING PROFESSORS: M. Ahrens, M. Engling, J. Mortensen, Y. Sun, S. Taneja

SENIOR INSTRUCTOR: J. M. Cuneo

INSTRUCTOR: T. Andrews

PROFESSORS EMERITUS: D. C. Brown, D. J. Dougherty, D. Finkel, M. Hofri, R. E. Kinicki, K. A. Lemone, S. M. Selkow

ASSOCIATED FACULTY: S. Barton (HUA), B. Calli (RBE), L. Fichera (RBE), T. Ghoshal (DS), X. Huang (ECE), B. Islam (ECE), A. Lammert (MA), Z. Li (RBE), O. Mangoubi (MA), W. Martin (MA), B. Michalson (RBE), K. Mus (ECE), C. Ngan (DS), R. Paffenroth (MA), K. Pahlavan (ECE), C. Pinciroli (RBE), N. Sanket (RBE), P. Schaumont (ECE), A. Wyglinski (ECE), J. Xiao (RBE), H. Zhang (BME), Z. Zhang (ECE)

Mission Statement

The mission of the Computer Science Department at WPI is to provide outstanding education to its undergraduate and graduate students in accordance with the principles of the WPI mission, to advance scholarship in key domains of the computing sciences, and to engage in activities that improve the welfare of society and enhance the reputation of WPI. The Department aims to maintain an environment that promotes innovative thinking, values mutual respect and diversity, encourages and supports scholarship, instills ethical behavior, and engenders life-long learning.

Program Educational Objectives

In support of its goals and mission, the WPI Computer Science undergraduate program's educational objectives are to graduate students who will

- achieve professional success due to their mastery of Computer Science theory and practice;
- become leaders in business, academia, and society due to a broad preparation in mathematics, science & engineering, communication, teamwork, and social issues;
- pursue lifelong learning and continuing professional development;
- use their understanding of the impact of technology on society for the benefit of humankind.

Program Outcomes

Based on the educational objectives, the specific educational outcomes for the WPI Computer Science undergraduate program are that by the time of graduation CS majors will have achieved

1. an understanding of programming language concepts;
2. knowledge of computer organization;
3. an ability to analyze computational systems;
4. knowledge of computer operating systems;
5. an understanding of the foundations of computer science;
6. an understanding of software engineering principles and the ability to apply them to software design;
7. an understanding of human-computer interaction;
8. completion of a large software project;
9. knowledge of advanced computer science topics;
10. an understanding of mathematics appropriate for computer science;
11. knowledge of probability and statistics;
12. an understanding of scientific principles;
13. an ability to design experiments and interpret experimental data;
14. an ability to undertake independent learning;
15. an ability to locate and use technical information from multiple sources;
16. an understanding of professional ethics;
17. an understanding of the links between technology and society;
18. an ability to participate effectively in a class or project team;
19. an ability to communicate effectively in speech;
20. an ability to communicate effectively in writing.

Computer Science Major

Degree Type
Bachelor of Science

The normal period of residency at WPI is 16 terms. In addition to the WPI requirements applicable to all students, the program distribution requirements for the Computer Science major include computer science, mathematics, and basic science and/or engineering science as follows. *Note that a cross-listed course may be counted toward only one of these three areas.*

Program Distribution Requirements for the Computer Science Major

Computer Science, including the MQP (Minimum 18/3 Units)

Only CS 1101, CS 1102 and computer science courses at the 2000-level or higher will count towards the computer science requirement. **CS 2119 will not count towards the computer science requirement**.

At least 5/3 units of the Computer Science requirement must consist of 4000-level or graduate CS courses, except for CS 5007.

Only one of CS 1101 and CS 1102 may count towards the computer science requirement. Only one of CS 2301 and CS 2303 may count towards the computer science requirement. Only one of CS 2102, CS 210X, and CS 2103 may count towards the computer science requirement.

1000 Level Computer Science Courses

Item #	Title	Units
CS 1004	Introduction to Programming for Non-Majors	1/3
CS 1101	Introduction to Program Design	1/3
CS 1102	Accelerated Introduction to Program Design	1/3

2000 Level Computer Science Courses

Item #	Title	Units
CS 2011	Introduction to Machine Organization and Assembly Language	1/3
CS 2022/MA 2201	Discrete Mathematics	1/3
CS 2102	Object-Oriented Design Concepts	1/3
CS 2103	Accelerated Object-Oriented Design Concepts	1/3
CS 2119	Application Building with Object-Oriented Concepts	1/3
CS 2223	Algorithms	1/3
CS 2301	Systems Programming for Non-Majors	1/3
CS 2303	Systems Programming Concepts	1/3

3000 Level Computer Science Courses

Item #	Title	Units
CS 3013	Operating Systems	1/3
CS 3041	Human-Computer Interaction	1/3
CS 3043	Social Implications of Information Processing	1/3
CS 3133	Foundations of Computer Science	1/3
CS 3431	Database Systems I	1/3
CS 3516	Computer Networks	1/3
CS 3733	Software Engineering	1/3

4000 Level Computer Science Courses

Item #	Title	Units
BCB 4002/CS 4802	Biovisualization	1/3
BCB 4003/CS 4803	Biological and Biomedical Database Mining	1/3
CS 4032/MA 3257	Numerical Methods for Linear and Nonlinear Systems	1/3
CS 4033/MA 3457	Numerical Methods for Calculus and Differential Equations	1/3
CS 4099	Special Topics in Computer Science	1/3
CS 4100/IMGD 4100	Artificial Intelligence for Interactive Media and Games	1/3
CS 4120	Analysis of Algorithms	1/3
CS 4123	Theory of Computation	1/3
CS 4233	Object-Oriented Analysis and Design	1/3
CS 4241	Webware: Computational Technology for Network Information Systems	1/3
CS 4300/IMGD 4300	Graphics, Simulation, and Aesthetics	1/3
CS 4341	Introduction to Artificial Intelligence	1/3
CS 4342	Machine Learning	1/3
CS 4401	Software Security Engineering	1/3
CS 4404	Tools and Techniques in Computer Network Security	1/3
CS 4432	Database Systems II	1/3
CS 4433/DS 4433	Big Data Management and Analytics	1/3
CS 4445	Data Mining and Knowledge Discovery in Databases	1/3
CS 4513	Distributed Computing Systems	1/3
CS 4515	Computer Architecture	1/3
CS 4516	Advanced Computer Networks	1/3
CS 4518	Mobile and Ubiquitous Computing	1/3
CS 4533	Techniques of Programming Language Translation	1/3
CS 4536	Programming Languages	1/3
CS 4731	Computer Graphics	1/3
CS 4732	Computer Animation	1/3
CS 4801/ECE 4802	Introduction to Cryptography and Communication Security	1/3
CS 4804	Data Visualization	1/3
MA 3457/CS 4033	Numerical Methods for Calculus and Differential Equations	1/3

Must include at least 1/3 unit from each of the following areas:

Systems

Item #	Title	Units
CS 3013	Operating Systems	1/3
CS 4513	Distributed Computing Systems	1/3
CS 4515	Computer Architecture	1/3
CS 4516	Advanced Computer Networks	1/3

In addition to these courses, any of the following graduate courses (when used as stated above) can be used to satisfy the undergraduate Systems area requirement: CS 502, CS 533, or CS 535.

Theory and Languages

Item #	Title	Units
CS 3133	Foundations of Computer Science	1/3
CS 4120	Analysis of Algorithms	1/3
CS 4123	Theory of Computation	1/3
CS 4533	Techniques of Programming Language Translation	1/3
CS 4536	Programming Languages	1/3

In addition to these courses, any of the following graduate courses (when used as described above) can be used to satisfy the undergraduate Theory and Languages area requirement: CS 5003, CS 5084, CS 503, CS 536, CS 544, or CS 584.

Design

Item #	Title	Units
CS 3041	Human-Computer Interaction	1/3
CS 3431	Database Systems I	1/3
CS 3733	Software Engineering	1/3
CS 4233	Object-Oriented Analysis and Design	1/3

In addition to these courses, any of the following graduate courses (when used as stated above) can be used to satisfy the undergraduate Design area requirement: CS 509, CS 542, CS 546, CS 561, or CS 562.

Social Implications of Computing

Item #	Title	Units
CS 3043	Social Implications of Information Processing	1/3
GOV 2314/ID 2314	Cyberlaw and Policy	1/3
GOV 2315	Privacy: Laws, Policy, Technology, and How They Fit Together	1/3
IMGD 2000	Social Issues in Interactive Media and Games	1/3
IMGD 2001	Philosophy and Ethics of Computer Games	1/3
RBE 3100	Social Implications of Robotics	1/3

If GOV/ID 2314, GOV/ID 2315, IMGD 2000, IMGD 2001 or RBE 3100 is used to satisfy this requirement, it does not count as part of the 6 units of CS.

Mathematics (Minimum 7/3 Units)

At most four 1000-level Mathematics courses may be counted towards this requirement.

Must include at least 1/3 unit from each of the following areas:

Probability

Item #	Title	Units
MA 2621	Probability for Applications	1/3
MA 2631	Probability Theory	1/3

Statistics

Item #	Title	Units
MA 2611	Applied Statistics I	1/3
MA 2612	Applied Statistics II	1/3

Basic Science and/or Engineering Science (Minimum 5/3 Units)

Courses satisfying the Basic Science requirement must come from the BB, BME, CE, CH, CHE, ECE, ES, GE, ME, PH, or RBE disciplines. At least three courses must come from BB, CH, GE, or PH, where at least two courses are from one of these disciplines.

Item #	Title	Units
BB 1001	Introduction to Biology	1/3
BB 1002	Environmental Biology	1/3
BB 1003/BCB 1003	Exploring Bioinformatics and Computational Biology	1/3
BB 1025	Human Biology	1/3
BB 1035	Biotechnology	1/3
BB 1045	Biodiversity	1/3
BB 2002	Microbiology	1/3
BB 2003	Fundamentals of Microbiology	1/3
BB 2030	Plant Diversity	1/3
BB 2040	Principles of Ecology	1/3
BB 2050	Animal Behavior	1/3
BB 2550	Cell Biology	1/3
BB 2902	Enzymes, Proteins, and Purification	1/6
BB 2903	Anatomy and Physiology	1/6
BB 2904	Ecology, Environment, and Animal Behavior	1/6
BB 2915	Searching for Solutions in Soil: Microbial and Molecular Investigations	1/3
BB 2917	Hunting for Phage	1/3
BB 2920	Genetics	1/3
BB 2950	Molecular Biology	1/3
BB 3003	Medical Microbiology: Plagues of the Modern World, a Case Study Approach	1/3
BB 3010/BCB 3010	Simulation in Biology	1/3
BB 3050	Cancer Biology	1/3
BB 3080	Neurobiology	1/3
BB 3101	Human Anatomy & Physiology: Movement and Communication	1/3
BB 3102	Human Anatomy & Physiology: Transport and Maintenance	1/3
BB 3120	Plant Physiology	1/3
BB 3140	Evolution: Pattern and Process	1/3
BB 3512	Molecular Genetics Lab	1/6
BB 3513	Cell Culture Techniques for Animal Cells	1/6
BB 3515	Physiologic Systems Laboratory	1/3
BB 3517	Fermentation	1/6
BB 3519	Protein Purification	1/6
BB 3521	Microscopy	1/6
BB 3525	Plant Physiology	1/6
BB 3526	Phage Hunters: the Analysis	1/6
BB 3527	Molecular Biology and Genetic Engineering: Approaches and Applications	1/3
BB 3530	Immunotherapies: The Next Generation of Pharmaceuticals	1/3
BB 3570	Cell Culture Models for Tissue Regeneration	1/3
BB 3620	Developmental Biology	1/3
BB 3920	Immunology	1/3
BB 4150	Environmental Change: Problems and Approaches	1/3
BB 4170/CH 4170	Experimental Genetic Engineering	1/3
BB 4190/CH 4190	Regulation of Gene Expression	1/3
BB 4260	Synthetic Biology	1/3
BB 4801/BCB 4001	Bioinformatics	1/3
BB 4900	Capstone Experience in Biology and Biotechnology	1/3

Item #	Title	Units
BME 1001	Introduction to Biomedical Engineering	1/3
BME 1004	Introduction to Programming in Matlab	1/3
BME 2001	Introduction to Biomaterials	1/3
BME 2210	Biomedical Signals, Instruments and Measurements	1/3
BME 2211	Biomedical Data Analysis	1/3
BME 2502	Introduction to Biomechanics: Stress Analysis	1/3
BME 2610	Introduction to Bioprocess Engineering	1/3
BME 3012	Biomedical Sensors Laboratory	1/6
BME 3013	Biomedical Instrumentation Laboratory	1/6
BME 3014	Physiological Signals Laboratory I: Techniques	1/6
BME 3111	Physiology and Engineering	1/3
BME 3112	Human Physiology for Biomedical Engineers	1/3
BME 3300	Biomedical Engineering Design	1/3
BME 3503	Skeletal Biomechanics Laboratory	1/6
BME 3505	Solid Biomechanics Laboratory: Techniques	1/6
BME 3506	Solid Biomechanics Laboratory: Applications	1/6
BME 3605	Biotransport Laboratory II: Applications	1/6
BME 3610	Transport Analysis in Bioengineering	1/3
BME 3811	Biomaterials Lab	1/6
BME 3813	Cellular Engineering Lab	1/6
BME 4011/ECE 4011	Biomedical Signal Analysis	1/3
BME 4023/ECE 4023	Biomedical Instrumentation Design	1/3
BME 4201	Biomedical Imaging	1/3
BME 4300	MQP Capstone Design	1/6
BME 4503	Computational Biomechanics	1/3
BME 4504/ME 4504	Biomechanics	1/3
BME 4606/ME 4606	Biofluids	1/3
BME 4701	Cell and Molecular Bioengineering	1/3
BME 4814/ME 4814	Biomaterials	1/3
BME 4828	Biomaterials-Tissue Interactions	1/3
BME 4831	Drug Delivery	1/3

Item #	Title	Units
CE 1030	Civil Engineering and Computer Fundamentals	1/3
CE 2000	Analytical Mechanics I	1/3
CE 2001	Analytical Mechanics II	1/3
CE 2002	Introduction to Analysis and Design	1/3
CE 2020	Surveying	1/3
CE 3006	Design of Steel Structures	1/3
CE 3008	Design of Reinforced Concrete Structures	1/3
CE 3010	Structural Engineering	1/3
CE 3020	Project Management	1/3
CE 3022	Legal Aspects of Professional Practice	1/3
CE 3025	Project Evaluation	1/3
CE 3026	Materials of Construction	1/3
CE 3030	Fundamentals of Civil Engineering Autocad	1/3
CE 3031	Building Information Modeling: Software Tools and Principles	1/3
CE 3041	Soil Mechanics	1/3
CE 3044	Foundation Engineering	1/3
CE 3050	Traffic Engineering	1/3
CE 3051	Pavement Engineering	1/3
CE 3059	Environmental Engineering	1/3
CE 3060	Water Treatment	1/3
CE 3061	Sustainable Wastewater Engineering: Treatment and Reuse	1/3
CE 3062	Hydraulics	1/3
CE 3070	Urban and Environmental Planning	1/3
CE 3074	Environmental Analysis	1/3
CE 4007	Matrix Analysis of Structures	1/3
CE 4060	Environmental Engineering Laboratory	1/3
CE 4061	Hydrology	1/3
CE 4063/CHE 4063	Transport & Transformations in the Environment	1/3
CE 4071	Land Use Development and Controls	1/3
CE 4600	Hazardous and Industrial Waste Management	1/3
CE 4610	Solid Waste Engineering	1/3

Chemistry and Biochemistry

Item #	Title	Units
BB 4170/CH 4170	Experimental Genetic Engineering	1/3
BB 4190/CH 4190	Regulation of Gene Expression	1/3
CH 1010	Chemical Properties, Bonding, and Forces	1/3
CH 1020	Chemical Reactions	1/3
CH 1030	Kinetics, Equilibrium and Thermodynamics	1/3
CH 1040	Spectroscopy in Organic and Polymer Chemistry	1/3
CH 2310	Organic Chemistry I	1/3
CH 2320	Organic Chemistry II	1/3
CH 2330	Organic Chemistry III	1/3
CH 2360	Organic Laboratory	1/3
CH 2640	Experimental Chemistry I: Instrumental Analysis	1/3
CH 2650	Modern Physical Chemistry Methods	1/3
CH 2660	Organic Synthesis and Analysis Laboratory	1/3
CH 2670	Investigation of Coordination Complexes Through Inquiry	1/3
CH 3310	Advanced Organic Chemistry	1/3
CH 3410	Structure, Bonding, and Reactivity in Inorganic Chemistry	1/3
CH 3510	Chemical Thermodynamics	1/3
CH 3530	Quantum Chemistry	1/3
CH 3550	Chemical Dynamics	1/3
CH 4110	Protein Structure and Function	1/3
CH 4120	Lipids and Biomembrane Functions	1/3
CH 4130	Nucleic Acids and Bioinformation	1/3
CH 4140	Metabolism and Disease	1/3
CH 4150	Enzymology and Protein Characterization Laboratory	1/3
CH 4160	Membrane Biophysics	1/3
CH 4330	Organic Synthesis	1/3
CH 4420	Principles and Applications of Group Theory in Chemistry	1/3
CH 4520	Chemical Statistical Mechanics	1/3

Chemical Engineering

Item #	Title	Units
CE 4063/CHE 4063	Transport & Transformations in the Environment	1/3
CHE 1011	Introduction to Chemical Engineering	1/3
CHE 2011	Chemical Engineering Fundamentals	1/3
CHE 2012	Elementary Chemical Processes	1/3
CHE 2013	Applied Chemical Engineering Thermodynamics	1/3
CHE 2014	Advanced Chemical Processes	1/3
CHE 3201	Kinetics and Reactor Design	1/3
CHE 3301	Introduction to Biological Engineering	1/3
CHE 3501	Applied Mathematics in Chemical Engineering	1/3
CHE 3702	Energy Challenges in the 21st Century	1/3
CHE 3722	Bioenergy	1/3
CHE 4401	Unit Operations of Chemical Engineering I	1/3
CHE 4402	Unit Operations of Chemical Engineering II	1/3
CHE 4403	Chemical Engineering Design	1/3
CHE 4404	Chemical Plant Design Project	1/3
CHE 4405	Chemical Process Dynamics and Control Laboratory	1/3
CHE 4410	Chemical Process Safety Design	1/3

Electrical and Computer Engineering

Item #	Title	Units
BME 4011/ECE 4011	Biomedical Signal Analysis	1/3
BME 4023/ECE 4023	Biomedical Instrumentation Design	1/3
CS 4801/ECE 4802	Introduction to Cryptography and Communication Security	1/3
ECE 1799	Frontiers and Current Issues of Electrical and Computer Engineering	1/6
ECE 2010	Introduction to Electrical and Computer Engineering	1/3
ECE 2019	Sensors, Circuits, and Systems	1/3
ECE 2029	Introduction to Digital Circuit Design	1/3
ECE 2049	Embedded Computing in Engineering Design	1/3
ECE 2112	Electromagnetic Fields	1/3
ECE 2201	Microelectronic Circuits I	1/3
ECE 2305	Introduction to Communications and Networks	1/3
ECE 2311	Continuous-Time Signal and System Analysis	1/3
ECE 2312	Discrete-Time Signal and System Analysis	1/3
ECE 2799	Electrical and Computer Engineering Design	1/3
ECE 3012	Introduction to Control Systems Engineering	1/3
ECE 3113	Introduction to RF Circuit Design	1/3
ECE 3204	Microelectronic Circuits II	1/3
ECE 3308	Introduction to Wireless Networks	1/3
ECE 3311	Principles of Communication Systems	1/3
ECE 3500	Electric Power and Renewable Energy Systems	1/3
ECE 3501	Electromechanical Energy Systems	1/3
ECE 3829	Advanced Digital System Design with FPGAs	1/3
ECE 3849	Real-Time Embedded Systems	1/3
ECE 4305	Software-Defined Radio Systems and Analysis	1/3
ECE 4503	Power Electronics And Power Management	1/3
ECE 4703	Real-Time Digital Signal Processing	1/3
ECE 4801	Computer Organization and Design	1/3
ECE 4902	Analog Integrated Circuit Design	1/3
ECE 4904	Semiconductor Devices	1/3

Engineering Science Interdisciplinary

Item #	Title	Units
ES 1020	Introduction to Engineering	1/3
ES 1310	Introduction to Computer Aided Design	1/3
ES 1500	Fundamentals of Systems Thinking	1/3
ES 2001	Introduction to Materials Science	1/3
ES 2501	Introduction to Static Systems	1/3
ES 2502	Stress Analysis	1/3
ES 2503	Introduction to Dynamic Systems	1/3
ES 2800	Environmental Impacts of Engineering Decisions	1/3
ES 3001	Introduction to Thermodynamics	1/3
ES 3002	Mass Transfer	1/3
ES 3003	Heat Transfer	1/3
ES 3004	Fluid Mechanics	1/3
ES 3011	Control Engineering I	1/3
ES 3323	Advanced Computer Aided Design	1/3
ES 3501	A Project-Based Introduction to Systems Engineering	1/3

Geosciences

Item #	Title	Units
GE 2341	Geology	1/3

Mechanical Engineering

Item #	Title	Units
BME 4504/ME 4504	Biomechanics	1/3
BME 4606/ME 4606	Biofluids	1/3
BME 4814/ME 4814	Biomaterials	1/3
ME 1520	The Technology of Alpine SkIIng	1/3
ME 1800	Manufacturing Science, Prototyping, and Computer-Controlled Machining	1/3
ME 2300	Introduction to Engineering Design	1/3
ME 2312	Introduction to Computational Solutions for Engineering Problems	1/3
ME 2820	Materials Processing	1/3
ME 3310	Kinematics of Mechanisms	1/3
ME 3311	Dynamics of Mechanisms and Machines	1/3
ME 3320	Design of Machine Elements	1/3
ME 3411	Intermediate Fluid Mechanics	1/3
ME 3501	Elementary Continuum Mechanics	1/3
ME 3506	Rehabilitation Engineering	1/3
ME 3820	Computer-Aided Manufacturing	1/3
ME 3901	Engineering Experimentation	1/3
ME 3902	Project-Based Engineering Experimentation	1/3
ME 4320	Advanced Engineering Design	1/3
ME 4323	Fundamentals of Drivetrain Systems	1/3
ME 4324	Integrated Design of Mechanical Systems	1/3
ME 4422	Design and Optimization of Thermal Systems	1/3
ME 4424	Radiation Heat Transfer Application and Design	1/3
ME 4429	Thermofluid Application and Design	1/3
ME 4430	Integrated Thermomechanical Design and Analysis	1/3
ME 4505	Advanced Dynamics	1/3
ME 4506	Mechanical Vibrations	1/3
ME 4512	Introduction to the Finite Element Method	1/3
ME 4710	Gas Turbines for Propulsion and Power Generation	1/3
ME 4813	Ceramics and Glasses for Engineering Applications	1/3
ME 4821	Plastics	1/3
ME 4832	Corrosion and Corrosion Control	1/3
ME 4840	Physical Metallurgy	1/3
ME 4875/MTE 575	Introduction to Nanomaterials and Nanotechnology	1/3
RBE 4322/ME 4322	Modeling and Analysis of Mechatronic Systems	1/3

Physics

Item #	Title	Units
PH 1110	General Physics—Mechanics	1/3
PH 1111	Principles of Physics—Mechanics	1/3
PH 1120	General Physics—Electricity and Magnetism	1/3
PH 1121	Principles of Physics—Electricity and Magnetism	1/3
PH 1130	Modern Physics	1/3
PH 1140	Oscillations and Waves	1/3
PH 1150	Introductory Physics of Living Systems	1/3
PH 2101	Principles of Thermodynamics	1/3
PH 2201	Intermediate Mechanics I	1/3
PH 2202	Intermediate Mechanics II	1/3
PH 2301	Electromagnetic Fields	1/3
PH 2501	Photonics	1/3
PH 2502	Lasers	1/3
PH 2510	Atomic Force Microscopy	1/3
PH 2520	Introduction to Astrophysics	1/3
PH 2540	Solar Systems	1/3
PH 2550/AE 2550	Atmospheric and Space Environments	1/3
PH 2601	Photonics Laboratory	1/3
PH 2651	Intermediate Physics Laboratory	1/3
PH 3206	Statistical Physics	1/3
PH 3301	Electromagnetic Theory	1/3
PH 3401	Quantum Mechanics I	1/3
PH 3402	Quantum Mechanics II	1/3
PH 3501	Relativity	1/3
PH 3502	Solid State Physics	1/3
PH 3503	Nuclear Physics	1/3
PH 3504	Optics	1/3
PH 4201/PH 511	Advanced Classical Mechanics	1/3

Robotics Engineering

Item #	Title	Units
RBE 1001	Introduction to Robotics	1/3
RBE 2001	Unified Robotics I: Actuation	1/3
RBE 2002	Unified Robotics II: Sensing	1/3
RBE 3001	Unified Robotics III: Manipulation	1/3
RBE 3002	Unified Robotics IV: Navigation	1/3
RBE 3100	Social Implications of Robotics	1/3
RBE 4322/ME 4322	Modeling and Analysis of Mechatronic Systems	1/3
RBE 4540	Vision-based Robotic Manipulation	1/3
RBE 4815	Industrial Robotics	1/3

Project Opportunities

Off-campus major qualifying projects are available at several project centers including those below.

Projects are also available on campus, both to support the ongoing research activities of the faculty and to expand and improve the applications of computers for service, education, and administration.

Additionally, the department supports IQPs in a number of areas.

Item #	Title	Units
	Lincoln Laboratory Project Center	
	Japan Project Center	
	Wall Street/FinTech Project Center	
	Silicon Valley Project Center	

Advanced Placement

Advanced placement in computer science can be earned for the “Computer Science AP A” exam. Credit for CS 1000 is granted for scoring a “4” or “5” on the CS AP A exam. No credit will be granted for “Computer Science AP Principles” exam.

The Computer Science department advises CS Majors who earn a “4” or a “5” on the CS AP A exam to enroll in CS 1102 (Accelerated Introduction to Program Design). Students who wish to pursue a CS Minor after earning a “4” or a “5” on the CS AP A exam may consider enrolling in CS 2119 (Application Building with Object-Oriented Concepts) or CS 2301 (Systems Programming for Non-Majors).

Students who took CS AP Principles exam and have substantial programming experience should consult with the CS course instructors as to which course to take.

Independent Study

Independent study and project work provide the opportunity for students, working under the direction of faculty members, to study or conduct research in an area not covered in courses or in which the students require a greater depth of knowledge. The background required of a student for independent study work depends on the particular area of study or research.

Additional Advice

For additional advice about course selections, students should consult with their academic advisor or the Computer Science Department Website (http://www.cs.wpi.edu/Undergraduate/).

Program Chart and/or Course Flow Chart

COMPUTER SCIENCE
Minimum 18/3

CORE COURSES
CS 1101 or CS 1102, CS 2011, CS 2022, CS 2102, CS 2223, CS 2303,
CS 3013, CS 3041, CS 3043, CS 3133, CS 3733
Note: Not all of the Core Courses are required for the BS degree;
see the program distribution requirements

SYSTEMS —Minimum 1/3
CS 3013, CS 4513, CS 4515, CS 4516

THEORY AND LANGUAGE—Minimum 1/3
CS 3133, CS 4120. CS 4123, CS 4533, CS 4536

DESIGN—Minimum 1/3
CS 3041, CS 3431, CS 3733, CS 4233

SOCIAL IMPLICATIONS—Minimum 1/3
CS 3043, GOV/ID 2314, GOV/ID 2315, IMGD 2000, IMGD 2001, RBE 3100
CS 3043 counts toward the 18/3 CS units required for major

ADVANCED LEVEL COURSES—Minimum 5/3

COMPUTER SCIENCE MQP—Minimum 3/3

SCIENCE
Minimum 5/3

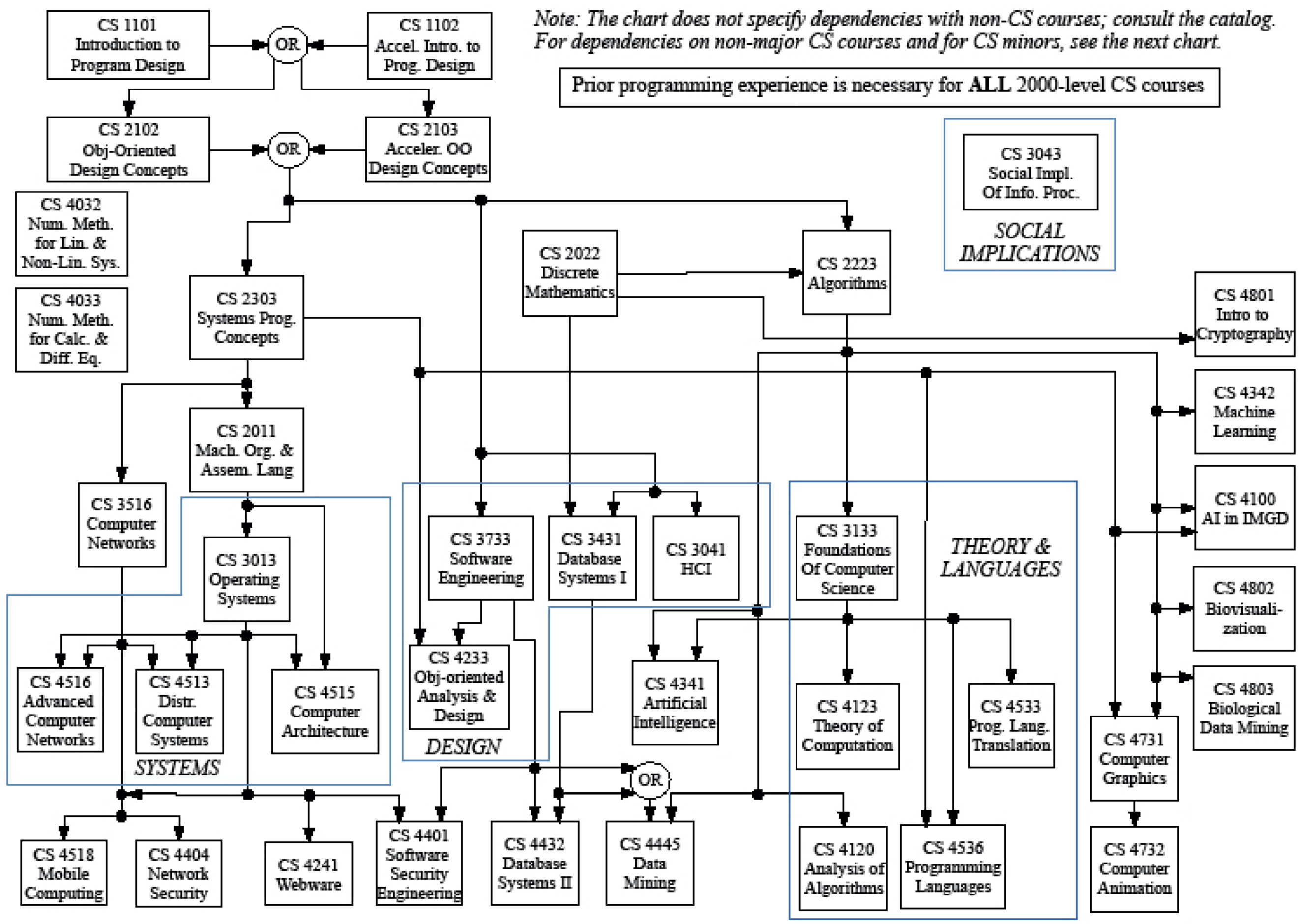
Any BB, BME, CE, CH, CHE, ECE, ES, GE, ME, PH, or RBE courses.
At least three courses must come from BB, CH, GE, or PH, where at least
two courses are from one of these disciplines.

MATHEMATICS
Minimum 7/3

At most four 1000-level Mathematics courses.
May include CS 2022 , CS 4032, or CS 4033 if not used to satisfy the CS requirements.

STATISTICS—Minimum 1/3
MA 2611, MA 2612

PROBABILITY—Minimum 1/3
MA 2621, MA 2631



Computer Science Minor

Degree Type

Minor

Program Distribution Requirements for the Computer Science Minor

Computer Science (Minimum 6/3 Units)

The Minor in Computer Science will consist of 2 units from Computer Science, with no more than one course at the 1000-level. The 2 units must include at least 1/3 unit CS at the 3000-level or above; however, CS 3043, CS 4032, and CS 4033 cannot be used for a CS minor. Alternatively, 1/3 unit of another activity, for example an ISU that has been validated by the CS faculty instructor as a capstone, can substitute for this requirement.

The Computer Science Department has an advisor for CS Minors, who can be reached at minoradvisor@cs.wpi.edu. Students are required to consult with the CS Minor Advisor before declaring the CS Minor. Majors in Computer Science do not qualify for a Minor in Computer Science. Students should review the Operational Rules of the Minor at WPI to avoid problems with double counting CS courses.

Computer Science Major with Concentration in Cyber Security

Degree Type

Concentration

Students pursuing a B.S. with Major in Computer Science may, at their option, choose to focus in the **Cyber Security Concentration**:

Program Requirements for the Cyber Security Concentration

Core Cyber Security (Minimum 2/3 Units)

In addition to the courses listed below, other Cyber Security-specific courses may be used to satisfy this requirement subject to program approval.

Item #	Title	Units
CS 4401	Software Security Engineering	1/3
CS 4404	Tools and Techniques in Computer Network Security	1/3
CS 4801/ECE 4802	Introduction to Cryptography and Communication Security	1/3

Societal Impacts of Security (Minimum 1/3 Units)

In addition to the courses listed below, other Cyber Security-related societal impacts courses may be used to satisfy this requirement subject to program approval.

Item #	Title	Units
CS 3043	Social Implications of Information Processing	1/3
GOV 2314/ID 2314	Cyberlaw and Policy	1/3

Additional Cyber Security Courses (Minimum 3/3 Units)

In addition to the courses listed below, other Cyber-Security-Related courses may be used to satisfy this requirement subject to program approval.

Item #	Title	Units
CS 3013	Operating Systems	1/3
CS 3516	Computer Networks	1/3
CS 4513	Distributed Computing Systems	1/3
CS 4516	Advanced Computer Networks	1/3
CS 4518	Mobile and Ubiquitous Computing	1/3

Cyber Security-related Major Qualifying Project (Minimum 3/3 Units)

Complete a Cyber Security-related Major Qualifying Project, subject to program approval. The Major Qualifying Project must include a significant Cyber Security component. The project must be advised or co-advised by a faculty member who is active in Cyber Security research or teaching.

Graduate courses may be counted towards the Cyber Security concentration at the discretion of the program.

Humanities & Arts

K. MONCRIEF, HEAD

S. BARTON, E. BOUCHER-YIP, J. CULLON, ASSOCIATE HEADS

PROFESSORS: F. Bianchi, K. Boudreau, J. J. Brattin, S. C. Bullock, J. Cocola, J. deWinter, B. Faber, R. S. Gottlieb, J. P. Hanlan, P. H. Hansen, K. Moncrief, J. Rosenstock, J. Rudolph, L. E. Schachterle

ASSOCIATE PROFESSORS: S. Barton, C. Clark, L. Eckelman, M. Ephraim, A. S. Madan, V. Manzo, J. McWeeny, A. A. Rivera, M. D. Samson, J. Sanbonmatsu, D. Spanagel

ASSISTANT PROFESSORS: L. Caplan, D. DiMassa, H. Droessler, E. Gutierrez, K. McIntyre, Y. Telliel

VISITING ASSISTANT PROFESSOR: D. Ibbett, S. Lucie, M. Scinto

PROFESSOR OF PRACTICE: K. Lewis

TEACHING PROFESSORS: E. Boucher-Yip, J. Cullon, L. Higgins

ASSOCIATE TEACHING PROFESSORS: U. Brisson, J. Harmon, R. Madan, I. Matos-Nin, S. Nikitina, J. Rohde

ASSISTANT TEACHING PROFESSORS: J. Aguilar, A. Danielski, L. Davis, W. Du, J. Galante, M. Halpine, M. Keller, S. Lessing, M. Lutch, R. Moody, D. Olsen, G. Pfeifer, W. San Martín, H. Zheng

ADJUNCT TEACHING PROFESSORS: W. Addison, W. Baller

SENIOR INSTRUCTOR: R. Bigonah

INSTRUCTOR/LECTURERS: M. Brahimi, P. Crowe, M. El Hamzaoui, A. Gonzalez

ADJUNCT FACULTY: J. Blumhofer, S. Burton, O. D'Ambrosio Scanlon, J. Duquette, P. Everett, M. Hatch Moysey, S. Hong-Sammons, S. Minichiello, C. Nakajima, T. O'Malley, S. Runstrom, P. Russell, G. Scott, M. Sethi, A. Shafer, M. Steinke, A. Vaudreuil, M. Warren, B. Wetters, F. Yu

PROFESSORS EMERITUS: W. A. B. Addison, Jr., D. B. Dollenmayer, B. Eddy, R. Falco, L. Fontanella, E. Hayes, C. Heventhal, K. P. Ljungquist, J. Manfra, L. Menides, W. T. Mott, E. M. Parkinson, T. Shannon, R. L. Smith, M. Sokal, S. Vick, D. Weeks, J. Zeugner

Mission Statement

We are committed to helping students develop both a knowledge of, and an ability to think critically about, the humanities and arts. We also seek to foster the skills and habits of inquiry necessary for such learning: analytical thought, clear communication, and creative expression. Such an education, we believe, provides a crucial foundation for responsible and effective participation in a complex world.

The courses listed below are general humanities courses and are intended to provide conceptual introductions to the major disciplines within the humanities. Students will encounter the basic methods of critical analysis and discussion required for the future investigation of the specific area they choose for their humanities and arts requirement. These courses emphasize patterns of thought, methods of inquiry, appropriate vocabulary, and critical attitudes needed to appreciate most fully various areas in the humanities; they are not intended as surveys or historical overviews. Consequently, in each course the subject matter used to develop and illustrate key concepts and approaches will change regularly. Practice in analytic thinking and writing will be a significant part of each course. The skills generated by these courses will greatly aid students in developing their themes and will be essential for the completion of the Humanities and Arts Requirement.

Concentrations for Humanities and Arts Majors

Humanities and Arts majors may focus their studies by choosing a Concentration within a specific area of the Humanities and Arts, or within an interdisciplinary area closely related to the Humanities and Arts. Concentrations within the Humanities and Arts Department comply with WPI's requirements for Concentrations. Students must complete an MQP and two units of integrated study in the area of their Concentration. Concentrations within the Humanities and Arts (History, Literature, Music, Philosophy, Religion, Theatre, Writing and Rhetoric, Art History, German Studies, Hispanic Studies) require two units of work in an area designated by specific disciplinary course prefixes, as described below. For example, a Concentration in History requires two units of HI courses at the 2000 level or higher and an MQP in history. Concentrations that are interdisciplinary in nature (American Studies, Environmental Studies, and Humanities Studies of Science and Technology) each require that courses be selected from specific lists of designated courses.

All of these Concentrations are excellent preparation for a variety of careers. Graduates of the Humanities and Arts major have gone to law, business, and medical schools, as well as to graduate programs in the discipline of their Humanities and Arts concentration. Some graduates have pursued careers as writers, teachers, engineers, or scientists. Other students have found work in the theatre as actors, technicians, or playwrights, or in music as composers or performers. The advantages our graduates find in their pursuit of further study and careers are the advantages of a rigorous study of the liberal arts: a good foundation in our cultural traditions and the cultural diversity of the world, and strong skills in research, analysis, writing, or performance.

In addition, since each Humanities and Arts major completes some technical work, either via the Distribution Requirements or a double major in a technical field, our graduates receive unique preparation as technological humanists. This educational experience gives them a distinct advantage in many fields in which a solid knowledge of engineering or science is increasingly valuable, such as environmental studies, theatre, or business. The Humanities and Arts major equips students with vital general professional skills and with broad cultural and technical perspectives. Our many courses devoted to international issues or to foreign languages and the active involvement of Humanities and Arts faculty in the university's global programs provides superb training for technological humanists interested in international issues. Whatever their specific area of concentration, majors in the Humanities and Arts gain an intellectual curiosity and openness to the diversity of human cultural achievements that will enrich their lives and enhance their careers.

Humanities and Arts Minors

Minors can be arranged in areas other than the above. See a professor in the appropriate discipline for further information about minors in other areas and interdisciplinary minors.

Humanities and Arts Major

Degree Type
Bachelor of Arts

Concentrations for Humanities and Arts Majors

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Double Major in Humanities and Arts

Students may pursue a double major in Humanities and Arts and any area of study at WPI. To pursue the double major, a student must satisfy the degree requirements of both disciplines including an MQP and Distribution Requirements. The double major in Humanities and Arts requires 6 units of studies in the Humanities and Arts, including the MQP and Inquiry Seminar or Practicum. Students interested in pursuing this option should contact Prof. B. Addison, Salisbury Labs, for additional information.

Program Distribution Requirements for the Humanities and Arts Major

Mathematics and Arts (including MQP) (Minimum 18/3 Units)

Humanities and Arts majors may choose to complete 2 units of work and an MQP in one of the following areas of concentration: History, Literature, Music, Philosophy/Religion, Theatre, Writing and Rhetoric, Art or Art History, German Studies, Hispanic Studies, American Studies, Environmental Studies, or Humanities Studies of Science and Technology.

The remaining 3 units of work may be from any area within the Humanities and Arts except that no less than 1 unit should be from an area of Humanities and Arts outside of the area of the student's main concentration.

Mathematics and Science (Minimum 6/3 Units)

Must include 2/3 units in mathematics and 2/3 units in basic science. The remaining 2/3 unit may be from mathematics, basic science or computer science.

Electives (Minimum 6/3 Units)

May be from any area except Air Force Aerospace Studies, Military Science, or Wellness and Physical Education. Courses used to satisfy other degree requirements (i.e. the IQP) may not be used to fulfill this requirement.

Liberal Arts and Engineering Major

Degree Type

Bachelor of Arts

DIRECTOR: K. BOUDREAU (HU), D. DIBIASIO (CHE)

The Directors will advise students; other faculty advisors can be assigned from among the Liberal Arts and Engineering Program Committee.

Mission Statement

The goal of the Liberal Arts and Engineering Bachelor of Arts (BA) degree is to provide an opportunity for students who want a broad background in engineering and other disciplines, as preparation for further studies in engineering or in other fields such as medicine, law, public policy, international and global studies, business, or wherever a solid technical background would give them a unique edge. The program is also designed to allow students to transfer to an engineering BS program with minimum loss of time.

For more information, see the Admissions website at https://www.wpi.edu/academics/departments/liberal-arts-engineering.

Program Educational Objectives

The Liberal Arts and Engineering degree recognizes that societal and technological issues are becoming more and more interdependent. Leaders of government, non-profit and for-profit organizations are typically educated in non-engineering disciplines yet increasingly would benefit from a more technological grounding. The Liberal Arts and Engineering major, with its emphasis on problem solving, will prepare students not only for further study in engineering but also for many other high-level careers, such as:

- Law
- Medicine and health care
- Energy policy
- Environmental policy
- Technology policy
- Finance
- Technology management
- International relations
- Public affairs and political service
- Performing arts, especially in music
- Consulting

Program Outcomes

Graduates of the BA in Liberal Arts and Engineering major will have:

- an ability to formulate and solve problems requiring knowledge of both technological and societal/humanistic needs and constraints
- an ability to apply, as needed, the relevant fundamentals of mathematics, science, engineering, social sciences, and the humanities to solve such problems
- an ability to use the techniques, skills, and modern tools necessary for professional practice
- an ability to function on multi-disciplinary teams
- an understanding of professional and ethical responsibility
- an ability to communicate effectively in oral, written and visual modes
- a recognition of the need for, and ability to engage in, life-long learning, in response to the ever-increasing pace of change affecting societal needs and opportunities

- the broad education necessary to understand the impact of professional solutions in a societal context, both locally and globally.

Programs of Study and Relevant Courses

The Liberal Arts and Engineering program will offer considerable curricular flexibility to accommodate a wide range of student interests, but at the same time will require students to be intentional about developing a - coherent program of study consistent with the program's objectives. Academic advising will play an important role in helping students plan their programs.

For more information and advice about the program, contact Prof. Kris Boudreau (kboudreau@wpi.edu) or David DiBiasio (dibiasio@wpi.edu).

The Engineering Science and Design component of the major (Distribution Requirement 2) must be approved by the Liberal Arts and Engineering Program Committee to ensure that it provides students with a focus in some area of engineering. Guidance and examples will be provided so that students know in advance what types of programs will be approved. The intent is to accommodate creative programs while avoiding programs that lack a coherent theme.

The Social and Humanistic Factors component (see Distribution Requirement 3 and Note 6) should consist of courses that complement engineering and technology to support the educational objectives of the program. The Program Committee will maintain and make available to students and advisors lists of current courses that are acceptable for credit toward this requirement.

Program Distribution Requirements for the Liberal Arts and Engineering Major

Mathematics and Basic Sciences (Minimum 3/3 Units)

1. Mathematics must include differential and integral calculus and either probability or statistics.
2. All courses with prefixes BB, CH, PH, or GE count toward this requirement. Must include at least 1/3 Unit each of BB, CH, and PH.

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Item #	Title	Units
BB 1001	Introduction to Biology	1/3
BB 1002	Environmental Biology	1/3
BB 1003/BCB 1003	Exploring Bioinformatics and Computational Biology	1/3
BB 1025	Human Biology	1/3
BB 1035	Biotechnology	1/3
BB 1045	Biodiversity	1/3
BB 2002	Microbiology	1/3
BB 2003	Fundamentals of Microbiology	1/3
BB 2030	Plant Diversity	1/3
BB 2040	Principles of Ecology	1/3
BB 2050	Animal Behavior	1/3
BB 2550	Cell Biology	1/3
BB 2902	Enzymes, Proteins, and Purification	1/6
BB 2903	Anatomy and Physiology	1/6
BB 2904	Ecology, Environment, and Animal Behavior	1/6
BB 2915	Searching for Solutions in Soil: Microbial and Molecular Investigations	1/3
BB 2917	Hunting for Phage	1/3
BB 2920	Genetics	1/3
BB 2950	Molecular Biology	1/3
BB 3003	Medical Microbiology: Plagues of the Modern World, a Case Study Approach	1/3
BB 3010/BCB 3010	Simulation in Biology	1/3
BB 3050	Cancer Biology	1/3
BB 3080	Neurobiology	1/3
BB 3101	Human Anatomy & Physiology: Movement and Communication	1/3
BB 3102	Human Anatomy & Physiology: Transport and Maintenance	1/3
BB 3120	Plant Physiology	1/3
BB 3140	Evolution: Pattern and Process	1/3
BB 3512	Molecular Genetics Lab	1/6
BB 3513	Cell Culture Techniques for Animal Cells	1/6
BB 3515	Physiologic Systems Laboratory	1/3
BB 3517	Fermentation	1/6
BB 3519	Protein Purification	1/6
BB 3521	Microscopy	1/6
BB 3525	Plant Physiology	1/6
BB 3526	Phage Hunters: the Analysis	1/6
BB 3527	Molecular Biology and Genetic Engineering: Approaches and Applications	1/3
BB 3530	Immunotherapies: The Next Generation of Pharmaceuticals	1/3
BB 3570	Cell Culture Models for Tissue Regeneration	1/3
BB 3620	Developmental Biology	1/3
BB 3920	Immunology	1/3
BB 4150	Environmental Change: Problems and Approaches	1/3
BB 4170/CH 4170	Experimental Genetic Engineering	1/3
BB 4190/CH 4190	Regulation of Gene Expression	1/3
BB 4260	Synthetic Biology	1/3
BB 4801/BCB 4001	Bioinformatics	1/3
BB 4900	Capstone Experience in Biology and Biotechnology	1/3
CH 1010	Chemical Properties, Bonding, and Forces	1/3
CH 1020	Chemical Reactions	1/3
CH 1030	Kinetics, Equilibrium and Thermodynamics	1/3
CH 1040	Spectroscopy in Organic and Polymer Chemistry	1/3

CH 2310	Organic Chemistry I	1/3
CH 2320	Organic Chemistry II	1/3
CH 2330	Organic Chemistry III	1/3
CH 2360	Organic Laboratory	1/3
CH 2640	Experimental Chemistry I: Instrumental Analysis	1/3
CH 2650	Modern Physical Chemistry Methods	1/3
CH 2660	Organic Synthesis and Analysis Laboratory	1/3
CH 2670	Investigation of Coordination Complexes Through Inquiry	1/3
CH 3310	Advanced Organic Chemistry	1/3
CH 3410	Structure, Bonding, and Reactivity in Inorganic Chemistry	1/3
CH 3510	Chemical Thermodynamics	1/3
CH 3530	Quantum Chemistry	1/3
CH 3550	Chemical Dynamics	1/3
CH 4110	Protein Structure and Function	1/3
CH 4120	Lipids and Biomembrane Functions	1/3
CH 4130	Nucleic Acids and Bioinformation	1/3
CH 4140	Metabolism and Disease	1/3
CH 4150	Enzymology and Protein Characterization Laboratory	1/3
CH 4160	Membrane Biophysics	1/3
CH 4330	Organic Synthesis	1/3
CH 4420	Principles and Applications of Group Theory in Chemistry	1/3
CH 4520	Chemical Statistical Mechanics	1/3

Engineering Science and Design (Minimum 3/3 Units)

1. Courses with prefixes AREN, BME, CE, CHE, CS, ECE, ES, ME, and RBE are eligible to count toward this requirement. These courses should be thematically related; students must gain approval of their program of study in this area from the Liberal Arts and Engineering Program Committee.
2. Must include either CS 1101 or CS 1102.
3. Must include at least one course in engineering design (such as ECE 2799 or ME 2300), plus at least two other courses with a significant laboratory component (a list of such courses will be maintained by the Liberal Arts and Engineering Program Committee).

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Item #	Title	Units
AREN 2002	Architectural Design I	1/3
AREN 2004	Architectural Design II - Light and Lighting Systems	1/3
AREN 2023	Introduction to Architectural Engineering Systems	1/3
AREN 2025	Building Electrical Systems	1/3
AREN 3002	Architectural Design III	1/3
AREN 3003	Principles of HVAC Design for Buildings	1/3
AREN 3005	Lighting Systems	1/3
AREN 3006	Advanced HVAC System Design	1/3
AREN 3020	Architectural Design IV - Building Energy Simulation	1/3
AREN 3022	Architectural Design V - Building Envelope Design	1/3
AREN 3024	Building Physics	1/3
AREN 3025	Building Energy Simulation	1/3
BB 4170/CH 4170	Experimental Genetic Engineering	1/3
BB 4190/CH 4190	Regulation of Gene Expression	1/3
BCB 4002/CS 4802	Biovisualization	1/3
BCB 4003/CS 4803	Biological and Biomedical Database Mining	1/3
BME 1001	Introduction to Biomedical Engineering	1/3
BME 1004	Introduction to Programming in Matlab	1/3
BME 2001	Introduction to Biomaterials	1/3
BME 2210	Biomedical Signals, Instruments and Measurements	1/3
BME 2211	Biomedical Data Analysis	1/3
BME 2502	Introduction to Biomechanics: Stress Analysis	1/3
BME 2610	Introduction to Bioprocess Engineering	1/3
BME 3012	Biomedical Sensors Laboratory	1/6
BME 3013	Biomedical Instrumentation Laboratory	1/6
BME 3014	Physiological Signals Laboratory I: Techniques	1/6
BME 3111	Physiology and Engineering	1/3
BME 3112	Human Physiology for Biomedical Engineers	1/3
BME 3300	Biomedical Engineering Design	1/3
BME 3503	Skeletal Biomechanics Laboratory	1/6
BME 3505	Solid Biomechanics Laboratory: Techniques	1/6
BME 3506	Solid Biomechanics Laboratory: Applications	1/6
BME 3605	Biotransport Laboratory II: Applications	1/6
BME 3610	Transport Analysis in Bioengineering	1/3
BME 3811	Biomaterials Lab	1/6
BME 3813	Cellular Engineering Lab	1/6
BME 4011/ECE 4011	Biomedical Signal Analysis	1/3
BME 4023/ECE 4023	Biomedical Instrumentation Design	1/3
BME 4201	Biomedical Imaging	1/3
BME 4300	MQP Capstone Design	1/6
BME 4503	Computational Biomechanics	1/3
BME 4504/ME 4504	Biomechanics	1/3
BME 4606/ME 4606	Biofluids	1/3
BME 4701	Cell and Molecular Bioengineering	1/3
BME 4814/ME 4814	Biomaterials	1/3
BME 4828	Biomaterials-Tissue Interactions	1/3
BME 4831	Drug Delivery	1/3
CE 4063/CHE 4063	Transport & Transformations in the Environment	1/3
CH 1010	Chemical Properties, Bonding, and Forces	1/3
CH 1020	Chemical Reactions	1/3
CH 1030	Kinetics, Equilibrium and Thermodynamics	1/3
CH 1040	Spectroscopy in Organic and Polymer Chemistry	1/3
CH 2310	Organic Chemistry I	1/3

CH 2320	Organic Chemistry II	1/3
CH 2330	Organic Chemistry III	1/3
CH 2360	Organic Laboratory	1/3
CH 2640	Experimental Chemistry I: Instrumental Analysis	1/3
CH 2650	Modern Physical Chemistry Methods	1/3
CH 2660	Organic Synthesis and Analysis Laboratory	1/3
CH 2670	Investigation of Coordination Complexes Through Inquiry	1/3
CH 3310	Advanced Organic Chemistry	1/3
CH 3410	Structure, Bonding, and Reactivity in Inorganic Chemistry	1/3
CH 3510	Chemical Thermodynamics	1/3
CH 3530	Quantum Chemistry	1/3
CH 3550	Chemical Dynamics	1/3
CH 4110	Protein Structure and Function	1/3
CH 4120	Lipids and Biomembrane Functions	1/3
CH 4130	Nucleic Acids and Bioinformation	1/3
CH 4140	Metabolism and Disease	1/3
CH 4150	Enzymology and Protein Characterization Laboratory	1/3
CH 4160	Membrane Biophysics	1/3
CH 4330	Organic Synthesis	1/3
CH 4420	Principles and Applications of Group Theory in Chemistry	1/3
CH 4520	Chemical Statistical Mechanics	1/3
CHE 1011	Introduction to Chemical Engineering	1/3
CHE 2011	Chemical Engineering Fundamentals	1/3
CHE 2012	Elementary Chemical Processes	1/3
CHE 2013	Applied Chemical Engineering Thermodynamics	1/3
CHE 2014	Advanced Chemical Processes	1/3
CHE 3201	Kinetics and Reactor Design	1/3
CHE 3301	Introduction to Biological Engineering	1/3
CHE 3501	Applied Mathematics in Chemical Engineering	1/3
CHE 3702	Energy Challenges in the 21st Century	1/3
CHE 3722	Bioenergy	1/3
CHE 4401	Unit Operations of Chemical Engineering I	1/3
CHE 4402	Unit Operations of Chemical Engineering II	1/3
CHE 4403	Chemical Engineering Design	1/3
CHE 4404	Chemical Plant Design Project	1/3
CHE 4405	Chemical Process Dynamics and Control Laboratory	1/3
CHE 4410	Chemical Process Safety Design	1/3
CS 1004	Introduction to Programming for Non-Majors	1/3
CS 1101	Introduction to Program Design	1/3
CS 1102	Accelerated Introduction to Program Design	1/3
CS 2011	Introduction to Machine Organization and Assembly Language	1/3
CS 2022/MA 2201	Discrete Mathematics	1/3
CS 2102	Object-Oriented Design Concepts	1/3
CS 2103	Accelerated Object-Oriented Design Concepts	1/3
CS 2119	Application Building with Object-Oriented Concepts	1/3
CS 2223	Algorithms	1/3
CS 2301	Systems Programming for Non-Majors	1/3
CS 2303	Systems Programming Concepts	1/3
CS 3013	Operating Systems	1/3
CS 3041	Human-Computer Interaction	1/3
CS 3043	Social Implications of Information Processing	1/3
CS 3133	Foundations of Computer Science	1/3
CS 3431	Database Systems I	1/3
CS 3516	Computer Networks	1/3
CS 3733	Software Engineering	1/3
CS 4032/MA 3257	Numerical Methods for Linear and Nonlinear Systems	1/3

CS 4033/MA 3457	Numerical Methods for Calculus and Differential Equations	1/3
CS 4099	Special Topics in Computer Science	1/3
CS 4100/IMGD 4100	Artificial Intelligence for Interactive Media and Games	1/3
CS 4120	Analysis of Algorithms	1/3
CS 4123	Theory of Computation	1/3
CS 4233	Object-Oriented Analysis and Design	1/3
CS 4241	Webware: Computational Technology for Network Information Systems	1/3
CS 4300/IMGD 4300	Graphics, Simulation, and Aesthetics	1/3
CS 4341	Introduction to Artificial Intelligence	1/3
CS 4342	Machine Learning	1/3
CS 4401	Software Security Engineering	1/3
CS 4404	Tools and Techniques in Computer Network Security	1/3
CS 4432	Database Systems II	1/3
CS 4433/DS 4433	Big Data Management and Analytics	1/3
CS 4445	Data Mining and Knowledge Discovery in Databases	1/3
CS 4513	Distributed Computing Systems	1/3
CS 4515	Computer Architecture	1/3
CS 4516	Advanced Computer Networks	1/3
CS 4518	Mobile and Ubiquitous Computing	1/3
CS 4533	Techniques of Programming Language Translation	1/3
CS 4536	Programming Languages	1/3
CS 4731	Computer Graphics	1/3
CS 4732	Computer Animation	1/3
CS 4801/ECE 4802	Introduction to Cryptography and Communication Security	1/3
CS 4804	Data Visualization	1/3
ECE 1799	Frontiers and Current Issues of Electrical and Computer Engineering	1/6
ECE 2010	Introduction to Electrical and Computer Engineering	1/3
ECE 2019	Sensors, Circuits, and Systems	1/3
ECE 2029	Introduction to Digital Circuit Design	1/3
ECE 2049	Embedded Computing in Engineering Design	1/3
ECE 2112	Electromagnetic Fields	1/3
ECE 2201	Microelectronic Circuits I	1/3
ECE 2305	Introduction to Communications and Networks	1/3
ECE 2311	Continuous-Time Signal and System Analysis	1/3
ECE 2312	Discrete-Time Signal and System Analysis	1/3
ECE 2799	Electrical and Computer Engineering Design	1/3
ECE 3012	Introduction to Control Systems Engineering	1/3
ECE 3113	Introduction to RF Circuit Design	1/3
ECE 3204	Microelectronic Circuits II	1/3
ECE 3308	Introduction to Wireless Networks	1/3
ECE 3311	Principles of Communication Systems	1/3
ECE 3500	Electric Power and Renewable Energy Systems	1/3
ECE 3501	Electromechanical Energy Systems	1/3
ECE 3829	Advanced Digital System Design with FPGAs	1/3
ECE 3849	Real-Time Embedded Systems	1/3
ECE 4305	Software-Defined Radio Systems and Analysis	1/3
ECE 4503	Power Electronics And Power Management	1/3
ECE 4703	Real-Time Digital Signal Processing	1/3
ECE 4801	Computer Organization and Design	1/3
ECE 4902	Analog Integrated Circuit Design	1/3
ECE 4904	Semiconductor Devices	1/3
MA 3457/CS 4033	Numerical Methods for Calculus and Differential Equations	1/3
ME 1520	The Technology of Alpine SkIIng	1/3

ME 1800	Manufacturing Science, Prototyping, and Computer-Controlled Machining	1/3
ME 2300	Introduction to Engineering Design	1/3
ME 2312	Introduction to Computational Solutions for Engineering Problems	1/3
ME 2820	Materials Processing	1/3
ME 3310	Kinematics of Mechanisms	1/3
ME 3311	Dynamics of Mechanisms and Machines	1/3
ME 3320	Design of Machine Elements	1/3
ME 3411	Intermediate Fluid Mechanics	1/3
ME 3501	Elementary Continuum Mechanics	1/3
ME 3506	Rehabilitation Engineering	1/3
ME 3820	Computer-Aided Manufacturing	1/3
ME 3901	Engineering Experimentation	1/3
ME 3902	Project-Based Engineering Experimentation	1/3
ME 4320	Advanced Engineering Design	1/3
ME 4323	Fundamentals of Drivetrain Systems	1/3
ME 4324	Integrated Design of Mechanical Systems	1/3
ME 4422	Design and Optimization of Thermal Systems	1/3
ME 4424	Radiation Heat Transfer Application and Design	1/3
ME 4429	Thermofluid Application and Design	1/3
ME 4430	Integrated Thermomechanical Design and Analysis	1/3
ME 4505	Advanced Dynamics	1/3
ME 4506	Mechanical Vibrations	1/3
ME 4512	Introduction to the Finite Element Method	1/3
ME 4710	Gas Turbines for Propulsion and Power Generation	1/3
ME 4813	Ceramics and Glasses for Engineering Applications	1/3
ME 4821	Plastics	1/3
ME 4832	Corrosion and Corrosion Control	1/3
ME 4840	Physical Metallurgy	1/3
ME 4875/MTE 575	Introduction to Nanomaterials and Nanotechnology	1/3
RBE 1001	Introduction to Robotics	1/3
RBE 2001	Unified Robotics I: Actuation	1/3
RBE 2002	Unified Robotics II: Sensing	1/3
RBE 3001	Unified Robotics III: Manipulation	1/3
RBE 3002	Unified Robotics IV: Navigation	1/3
RBE 3100	Social Implications of Robotics	1/3
RBE 4322/ME 4322	Modeling and Analysis of Mechatronic Systems	1/3
RBE 4540	Vision-based Robotic Manipulation	1/3
RBE 4815	Industrial Robotics	1/3
SD 1510	Introduction to System Dynamics Modeling	1/3
SD 2520	Modeling Economic and Social Systems	1/3
SD 2530	Advanced Topics in System Dynamics Modeling	1/3
SD 3550	System Dynamics Seminar	1/3

Humanities and Arts, Social Science, and Business Topics (Minimum 3/3 Units)

1. Must include 2 Units of Humanities and Arts and Social Science. Courses with prefixes AR, HI, MU, PY, RH, WR, IMGD, ECON, GOV, PSY, STS, and SD may be eligible to count toward this requirement. Courses must be selected from areas that strongly complement the practice of engineering, such as the history of technology, ethics, writing and visual rhetoric, economics, society-technology studies, and environmental studies. A list of such courses will be maintained by the Liberal Arts and Engineering Program Committee.

2. May include up to 1 Unit of Business. All courses with prefixes ACC, BUS, ETR, FIN, MIS, MKT, OIE, and OBC are eligible to count toward this requirement.

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Item #	Title	Units
ACC 2060	Financial Statements for Decision Making	1/3
ACC 2101	Management Accounting	1/3
AR 1100	Essentials of Art	1/3
AR 1101	Digital Imaging and Computer Art	1/3
AR 1111	Introduction to Art History	1/3
AR 2048/IMGD 2048	Technical Art and Character Rigging	1/3
AR 2101/IMGD 2101	3D Modeling I	1/3
AR 2111	Modern Art	1/3
AR 2114	Modern Architecture in the American Era, 1750-2001 and Beyond	1/3
AR 2115	Topics in Architecture Since 1960	1/3
AR 2202	Figure Drawing	1/3
AR 2222/IMGD 2222	2D Animation I	1/3
AR 2301	Graphic Design	1/3
AR 2333/IMGD 2333	3D Animation I	1/3
AR 2401	Video Production	1/3
AR 2700/IMGD 2700	Digital Painting	1/3
AR 2740/IMGD 2740	3D Environmental Modeling	1/3
AR 2750	Topics in Studio Art	1/3
AR 3101/IMGD 3101	3D Modeling II	1/3
AR 3112	Modernism, Mass Culture, and the Avant-Garde	1/3
AR 3150/ID 3150	Light, Vision and Understanding	1/3
AR 3200/IMGD 3200	Interactive Electronic Arts	1/3
AR 3210/IMGD 3210	Human Figure in Motion	1/3
AR 3222/IMGD 3222	2D Animation II	1/3
AR 3333/IMGD 3333	3D Animation II	1/3
AR 3700/IMGD 3700	Concept Art and Creative Illustration	1/3
BUS 1020	Global Environment of Business Decisions	1/3
BUS 2001	WPI Means Business	1/3
BUS 2020	The Legal Environment of Business Decisions	1/3
BUS 2080	Data Analysis for Decision Making	1/3
BUS 4300	Senior Seminar	1/3
CS 4100/IMGD 4100	Artificial Intelligence for Interactive Media and Games	1/3
CS 4300/IMGD 4300	Graphics, Simulation, and Aesthetics	1/3
ECON 1110	Introductory Microeconomics	1/3
ECON 1120	Introductory Macroeconomics	1/3
ECON 2110	Intermediate Microeconomics	1/3
ECON 2120	Intermediate Macroeconomics	1/3
ECON 2126	Public Economics	1/3
ECON 2130	Econometric Modeling	1/3
ECON 2135	Information Economics and Policy	1/3
ECON 2145	Behavioral Economics	1/3
ECON 2155	Experimental Economics	1/3
ECON 2910/ETR 2910	Economics and Entrepreneurship	1/3
ENV 2500/PSY 2500	Psychology for Sustainability	1/3
FIN 3300	Finance & Technology (FinTech)	1/3
FIN 3310	Financial Markets and Digital Currencies	1/3
FIN 3330	Financial Analysis	1/3
GOV 1301	U.S. Government	1/3
GOV 1303	American Public Policy	1/3
GOV 1310	Law, Courts, and Politics	1/3
GOV 1320	Topics in International Politics	1/3
GOV 2302	Science-Technology Policy	1/3
GOV 2310	Constitutional Law: Foundations of Government	1/3

GOV 2311	Environmental Policy and Law	1/3
GOV 2313	Intellectual Property Law	1/3
GOV 2314/ID 2314	Cyberlaw and Policy	1/3
GOV 2315	Privacy: Laws, Policy, Technology, and How They Fit Together	1/3
GOV 2319/ENV 2319	Global Environmental Politics	1/3
GOV 2320	Constitutional Law: Civil Rights and Liberties	1/3
GOV 3000/PSY 3000	Psychology and Law	1/3
GOV 3312	International Environmental Policy	1/3
HI 1311	Introduction to American Urban History	1/3
HI 1313	The US and the World	1/3
HI 1314	Introduction to Early American History	1/3
HI 1322	Introduction to European History	1/3
HI 1330	Introduction to the History of Science and Technology	1/3
HI 1333	Introduction to American Histories of Protest and Power	1/3
HI 1345	Atlantic Worlds	1/3
HI 1350	Introduction to Environmental History	1/3
HI 2310	Topics in Urban History	1/3
HI 2311	American Colonial History	1/3
HI 2313	American History, 1789-1877	1/3
HI 2314	American History, 1877-1920	1/3
HI 2315	The Shaping of Post-1920 America	1/3
HI 2316	Twentieth Century American Foreign Relations	1/3
HI 2318	Topics in Law, Justice and American Society	1/3
HI 2320	Modern European History	1/3
HI 2328	History of Revolutions in the Twentieth Century	1/3
HI 2329	European Empires	1/3
HI 2335	Topics in the History of American Science and Technology	1/3
HI 2341	Contemporaryworld Issues in Historical Perspective	1/3
HI 2343	East Asia: China at the Center	1/3
HI 2345	Welcome to Paradise: the U.S. and the Caribbean	1/3
HI 2350	Topics in the History of Science	1/3
HI 2351	History of Ecology	1/3
HI 2400	Topics in Environmental History	1/3
HI 2401	U.S. Environmental History	1/3
HI 2403	Global Environmental History	1/3
HI 2900	Topics in Gender and History	1/3
HI 2913	Capitalism and Its Discontents	1/3
HI 2921	Topics in Modern European History	1/3
HI 2930	Topics in Latin American History	1/3
HI 3312	Topics in American Social History	1/3
HI 3314	The American Revolution	1/3
HI 3316	Topics in Twentieth-Century U.S. History	1/3
HI 3317	Topics in Environmental History	1/3
HI 3331	Topics in the History of European Science and Technology	1/3
HI 3333	Topics in American Technological Development	1/3
HI 3334	Topics in the History of American Science and Technology	1/3
HI 3335	Topics in the History of Non-Western Science and Technology	1/3
HI 3341	Topics in Imperial and Postcolonial History	1/3
HI 3343	Topics in Asian History	1/3
HI 3344	Pacific Worlds	1/3
IMGD 1000	Critical Studies of Interactive Media and Games	1/3
IMGD 1001	The Game Development Process	1/3
IMGD 1002	Storytelling in Interactive Media and Games	1/3
IMGD 2000	Social Issues in Interactive Media and Games	1/3
IMGD 2001	Philosophy and Ethics of Computer Games	1/3
IMGD 2030	Game Audio I	1/3

IMGD 2450/WR 2450	Narrative Design for Interactive Media and Games	1/3
IMGD 2500	Design of Tabletop Strategy Games	1/3
IMGD 2900	Digital Game Design I	1/3
IMGD 2905	Data Analysis for Game Development	1/3
IMGD 3000	Technical Game Development I	1/3
IMGD 3030	Game Audio II	1/3
IMGD 3100	Novel Interfaces for Interactive Environments	1/3
IMGD 3450/WR 3450	Writing Characters for Interactive Media & Games	1/3
IMGD 3500	Artistic Game Development I	1/3
IMGD 3900	Digital Game Design II	1/3
IMGD 4000	Technical Game Development II	1/3
IMGD 4030	Advanced Topics in Interactive Audio	1/3
IMGD 4099	Special Topics in IMGD	1/6
IMGD 4200	History and Future of Immersive and Interactive Media	1/3
IMGD 4403	Motion Capture Techniques	1/3
IMGD 4500	Artistic Game Development II	1/3
IMGD 4600	Serious Games	1/3
IMGD 4700	Advanced Storytelling: Quest Logic and Level Design	1/3
IMGD 4900	Digital Game Design Studio	1/3
MIS 2300	Business Applications of Blockchain	1/3
MIS 3010	Creating Value Through Innovation	1/3
MIS 3720	Business Data Management	1/3
MIS 3730	Artificial Intelligence with Business Application	1/3
MIS 3787	Business Applications of Machine Learning	1/3
MIS 4084	Business Intelligence	1/3
MIS 4720	Systems Analysis and Design	1/3
MIS 4741	User Experience and Design	1/3
MKT 3640	Management of Process and Product Innovation	1/3
MKT 3650	Consumer Behavior	1/3
MKT 4030	Achieving Strategic Effectiveness	1/3
MU 1511	Introduction to Music	1/3
MU 1611	Fundamentals of Music I	1/3
MU 2300	Foundations of Music Technology	1/3
MU 2501/PSY 2501	Music and Mind	1/3
MU 2611	Fundamentals of Music II	1/3
MU 2631	Glee Club	1/3
MU 2632	Alden Voices	1/3
MU 2633	Brass Ensemble	1/3
MU 2636	Concert Band	1/3
MU 2637	Orchestra	1/3
MU 2638	Chamber Choir	1/3
MU 2639	String Quartet	1/3
MU 2640	African Drumming Ensemble	1/3
MU 2641	Percussion Ensemble	1/3
MU 2642	Jazz Combo	1/3
MU 2643	Jazz Ensemble	1/3
MU 2644	Stage Band	1/3
MU 2719	Jazz History	1/3
MU 2720	Music History I: Medieval Through the Baroque	1/3
MU 2721	Music History II: Classical to the Present	1/3
MU 2722	History of American Popular Music	1/3
MU 2723	Music Composition	1/3
MU 2801	Making Music with Machines	1/3
MU 3001	World Music	1/3
MU 3002	Arranging and Orchestration	1/3
MU 3510	Music in Time of Conflict	1/3

MU 3614	Topics in Midi	1/3
MU 3615	Topics in Digital Sound	1/3
MU 3616	Topics in Interactive Programming	1/3
MU 3620	Electronic Music Composition	1/3
MU 3730	Jazz Theory	1/3
MU 4621	Independent Instruction (Lessons) in Music	1/3
OBC 1010	Leadership Practice	1/3
OIE 3020	Achieving Effective Operations	1/3
PSY 1400	Introduction to Psychological Science	1/3
PSY 1401	Cognitive Psychology	1/3
PSY 1402	Social Psychology	1/3
PSY 1404	Developmental Psychology	1/3
PSY 1412	Mental Health	1/3
PSY 1504	Strategies for Improving Cognitive Skills	1/3
PSY 1800	Special Topics in Psychological Science	
PSY 2401	The Psychology of Education	1/3
PSY 2406	Cross-Cultural Psychology: Human Behavior in Global Perspective	1/3
PSY 2407	Psychology of Gender	1/3
PSY 2408	Health Psychology	1/3
PSY 2410	School Psychology	1/3
PSY 2504	Human Sexuality	1/3
PSY 2800	Special Topics in Psychological Science	
PSY 2900	Introduction to Research in Psychological Science	0/6
PSY 3400	Survey Design and Methodology	1/3
PSY 3500	Experimental Design and Analysis	1/3
PSY 3800	Special Topics in Psychological Science	
PSY 3900	Research in Psychological Science	0/6
PSY 4110	Psychophysiology	1/3
PSY 4800	Special Topics in Psychological Science	
PSY 4900	Advanced Research in Psychological Science	0/6
PY 1731/RE 1731	Introduction to Philosophy and Religion	1/3
PY 2711	Epistemology	1/3
PY 2712	Social and Political Philosophy	1/3
PY 2713	Bioethics	1/3
PY 2716/RE 2716	Gender, Race, and Class	1/3
PY 2717	Philosophy and the Environment	1/3
PY 2718	Existentialism and Phenomenology	1/3
PY 2719	Philosophy of Science	1/3
PY 2731/RE 2731	Ethics	1/3
PY 2734	Philosophy and Spirituality	1/3
PY 3712	Philosophy of Religion	1/3
PY 3721/RE 3721	Topics in Religion	1/3
RE 3711/PY 3711	Topics in Philosophy	1/3
WR 1010	Elements of Writing	1/3
WR 1011	Writing About Science & Technology	1/3
WR 1020	Introduction to Rhetoric	1/3
WR 2010	Elements of Style	1/3
WR 2210	Business Writing and Communication	1/3
WR 2310	Visual Rhetoric	1/3
WR 2500	Writing in the Life Sciences	1/3
WR 3011	Teaching Writing	1/3
WR 3112	Rhetorical Theory	1/3
WR 3210	Technical Writing	1/3
WR 3214	Writing About Disease & Public Health	1/3
WR 3300	Cross-Cultural Communication	1/3

WR 4111	Research Methods in Writing	1/3
WR 4210	Medical Writing	1/3

MQP (Minimum 3/3 Units)

The MQP provides a capstone experience that builds on both the technical (Engineering Science and Design) and nontechnical (Humanities and Arts, Social Science, and Business Topics) components of the student's particular program. At least one advisor to the MQP must be a member of the Liberal Arts and Engineering Associated Faculty.

Program Chart and/or Course Flow Chart

Table 1: BA in Liberal Arts and Engineering			
Three (3) examples; others possible			
15 Units	ECE Design	Energy and Environment	Engineering and Pre-Law
WPI General Education Institutional Requirements (5 Units)			
1 H&A	HU&A of student's choice	HI 1332	HI 2317
2 H&A	HU&A	HI 2324	EN/WR 2211
3 H&A	HU&A	HI 2331	EN/WR 3214
4 H&A	HU&A	HI 2334	EN/WR 3216
5 H&A	HU&A	HI 3331	RH 3112
6 H&A	HU 3900 or HU 3910	HU 3900 or HU 3910	HU 3900 or HU 3910
7 SS	SS	PSY 1402	SOC 1202
8 SS	SS	SS/ID 2050	GOV 1301
9 PE	PE	PE	PE
10 Free Elective	Free Elective	Free Elective	Free Elective
11 Free Elective	Free Elective	Free Elective	Free Elective
12 Free Elective	Free Elective	Free Elective	Free Elective
13 IQP	IQP	IQP	IQP
14 IQP	IQP	IQP	IQP
15 IQP	IQP	IQP	IQP
Mathematics and Science (3 Units)			
16 Math & Science	MA 1021	MA 1021	MA 1021
17 Math & Science	MA 1022	MA 1022	MA 1022
18 Math & Science	MA 1024	MA 1024	MA 1024
19 Math & Science	MA 2051	MA 2051	MA 2051
20 Math & Science	MA 2611	MA 2611	MA 2611
21 Math & Science	CH 1010	CH 1010	CH 1010
22 Math & Science	PH 1110	CH 1020	BB 1035
23 Math & Science	PH 1120	BB 1002	PH 1110
24 Math & Science	BB 1001	PH 1110	PH 1120
Engineering Studies Cornerstone (3 Units)			
Theme	ECE	Energy	Eng Science and Design
25 Engineering Sci/Des	ECE 2010	ES 3001	ES 1020
26 Engineering Sci/Des	ECE 2019	ES 3003	ES 1310
27 Engineering Sci/Des	ECE 2029	ES 3004	ES 2001
28 Engineering Sci/Des	ECE 2049	ES 2501	ES 2501
29 Engineering Sci/Des	ECE 2112	ECE 2010	ES 2502
30 Engineering Sci/Des	ECE 2201	ECE 2019	ES 2503
31 Engineering Sci/Des	ECE 2311	ECE 3501	ES 3003
32 Engineering Sci/Des	ECE 2799 (design)	ME 2300 (design)	ME 2300 (design)
33 Engineering Sci/Des	CS 1101	CS 1101	CS 1101
Liberal Arts Cornerstone (3 Units)			
Theme	Social, Humanistic, Business Factors of Design	Environment and Policy	Pre Law
34 Liberal Studies	PY 2714 Ethics in the Professions	PY 2717 Phil.&Environ.	GOV 1303 American Pub. Policy
35 Liberal Studies	HI 1332 History of Technology	GOV 2311 Ev. Policy & Law	GOV 1310 Law, Courts, Politics
36 Liberal Studies	HI 3331 Topics in Society/Technology Studies	ENV 2400 Environmental Problems and Human Behavior	GOV 2313 Intellectual Property Law
37 Liberal Studies	GOV 2313 Intellectual Property Law	GOV 2312 International EV Policy	GOV 2314 Cyberlaw and Policy
38 Liberal Studies	GOV 2302 Science and Technology Policy	HI 3333 American Technology Development	GOV 2304 Govt. Decision Making and Admin Law
39 Liberal Studies	GOV 2314 Cyberlaw and Policy	GOV 2302 Science and Technological Policy	
40 Liberal Studies	OIE 2850 Engineering Economics	ENV 1100 Introduction to Environmental Studies	BUS 2020 Legal Environment of Business Decisions
41 Liberal Studies	BUS 2020 Legal Environment of Business Decisions	ENV 2200 Environmental Studies in the Various Disciplines	OIE 2850 Engineering Economics
42 Liberal Studies	ETR 3915 Entrepreneurial Business Models	ENV 4400 Senior Seminar in Environmental Studies	FIN 3300 Finance, Risk Analytics & Technology
MQP – aimed at confluence of engineering and liberal arts cornerstones (1 Unit)			
43 MQP	MQP	MQP	MQP
44 MQP	MQP	MQP	MQP
45 MQP	MQP	MQP	MQP

Professional Writing Major

Degree Type

Bachelor of Science

DIRECTOR: K. LEWIS (HUA)

CORE FACULTY: K. Fontenot (HUA), S. Lessing (HUA), R. Madan (HUA), S. Riddick (HUA), Y. Telliel (HUA)

AFFILIATED FACULTY: E.Boucher-Yip (HUA), A. Danielski (HUA), B. Faber (BME)

ADJUNCT INSTRUCTORS: S. Duguay, S. Runstrom

The goal of the Professional Writing program is to prepare professionals to communicate scientific or technical content to a variety of specialized and non-specialized audiences in useful and accessible ways.

Professional Writing is an interdisciplinary major or double major that combines work in written, oral, visual, and data- based communication with a strong concentration in a scientific or technical field. Students receive individual attention from academic advisors as they design a plan of study that fulfills the program's distribution requirements and best suits their intellectual interests and career aspirations. Majors can select courses and projects in a variety of areas, such as:

- Science writing, medical writing, health communication
- Technical writing, user documentation, online documentation
- Digital media, visual communication, information design
- Writing in the public interest, writing for non-profits
- Bilingual professional communication, translation

The Professional Writing major provides excellent preparation for students interested in careers in technical and scientific communication, writing and editing, web authoring, information design, public relations, medical writing, translation, and intercultural communication. It prepares students for graduate work. Finally, it prepares professionals in scientific or technical fields to be lead communicators in their careers.

MQP advisors will help students design projects that focus on the student's specific area of interest.

Program Distribution Requirements for the Professional Writing Major

Scientific and/or Technical Concentration (Minimum 18/3 Units)

The student's scientific and/or technical concentration must be a plan of study, approved by the student's program review committee, with a clear underlying rationale in mathematics, basic science, computer science, engineering, and/or business.

Writing and Rhetoric (WR) Concentration (Minimum 9/3 Units)

The Writing and Rhetoric concentration consists of 9/3 units from the 2 following categories.

Writing and Rhetoric (6/3 units)

Selected from any of the existing WR courses or equivalent ISUs. This must include WR 3112: Rhetorical Theory unless a substitution is authorized by the student's program review committee, which will be granted only under unusual circumstances. No more than one course at the 1000-level can be applied, and students must complete at least one 4000-level course in WR.

1000 Level Writing and Rhetoric Courses

Item #	Title	Units
WR 1010	Elements of Writing	1/3
WR 1011	Writing About Science & Technology	1/3
WR 1020	Introduction to Rhetoric	1/3

2000 Level Writing and Rhetoric Courses

Item #	Title	Units
IMGD 2450/WR 2450	Narrative Design for Interactive Media and Games	1/3
WR 2010	Elements of Style	1/3
WR 2210	Business Writing and Communication	1/3
WR 2310	Visual Rhetoric	1/3
WR 2500	Writing in the Life Sciences	1/3

3000 Level Writing and Rhetoric Courses

Item #	Title	Units
IMGD 3450/WR 3450	Writing Characters for Interactive Media & Games	1/3
WR 3011	Teaching Writing	1/3
WR 3112	Rhetorical Theory	1/3
WR 3210	Technical Writing	1/3
WR 3214	Writing About Disease & Public Health	1/3
WR 3300	Cross-Cultural Communication	1/3

4000 Level Writing and Rhetoric Courses

Item #	Title	Units
WR 4111	Research Methods in Writing	1/3
WR 4210	Medical Writing	1/3

Electives (3/3 Unit)

The 3/3 unit of electives must be coherently defined and approved by the student's program review committee. Students may draw on courses in Writing and Rhetoric not used to fulfill the above 6/3 units requirement or suggested courses from the categories below:

Courses in Science, Technology, and Culture Studies

Item #	Title	Units
AR 3150/ID 3150	Light, Vision and Understanding	1/3
CS 3041	Human-Computer Interaction	1/3
CS 3043	Social Implications of Information Processing	1/3
EN 2252	Science and Scientists in Modern Literature	1/3
GOV 2302	Science-Technology Policy	1/3
HI 3331	Topics in the History of European Science and Technology	1/3
HI 3333	Topics in American Technological Development	1/3
HI 3334	Topics in the History of American Science and Technology	1/3
IMGD 2000	Social Issues in Interactive Media and Games	1/3
IMGD 2001	Philosophy and Ethics of Computer Games	1/3
PSY 2406	Cross-Cultural Psychology: Human Behavior in Global Perspective	1/3

Philosophy and Ethics Courses

Item #	Title	Units
PY 2711	Epistemology	1/3
PY 2713	Bioethics	1/3
PY 2716/RE 2716	Gender, Race, and Class	1/3
PY 2717	Philosophy and the Environment	1/3
PY 2718	Existentialism and Phenomenology	1/3
PY 2731/RE 2731	Ethics	1/3

Foreign Language Courses

Item #	Title	Units
AB 1531	Elementary Arabic I	1/3
AB 1532	Elementary Arabic II	1/3
AB 1533	Elementary Arabic III	1/3
AB 2531	Intermediate Arabic I	1/3
AB 2532	Intermediate Arabic II	1/3
AB 2533	Intermediate Arabic III	1/3
CN 1541	Elementary Chinese I	1/3
CN 1542	Elementary Chinese II	1/3
CN 1543	Elementary Chinese III	1/3
CN 2541	Intermediate Chinese I	1/3
CN 2542	Intermediate Chinese II	1/3
CN 2543	Intermediate Chinese III	1/3
CN 2544	Intermediate Chinese IV	1/3
CN 3541	Advanced Chinese I	1/3
CN 3542	Advanced Chinese II	1/3
CN 3543	Advanced Chinese III	1/3
CN 3561	Business Chinese	1/3
GN 1511	Elementary German I: Identities and Communities	1/3
GN 1512	Elementary German II: Navigating Everyday Life in German-speaking Contexts	1/3
GN 2511	Intermediate German I: Cultural Practices and Products of the German-Speaking World	1/3
GN 2512	Intermediate German II: Pasts, Presents, and Futures of the German-Speaking World	1/3
GN 3511	Advanced German I: Exploration and Innovation in the German-Speaking World	1/3
GN 3512	Advanced German II: National Identities and Stories	1/3
SP 1523	Elementary Spanish I	1/3
SP 1524	Elementary Spanish II	1/3
SP 2521	Intermediate Spanish I	1/3
SP 2522	Intermediate Spanish II	1/3
SP 3521	Advanced Spanish I	1/3
SP 3522	Advanced Spanish II	1/3

Business Courses

Item #	Title	Units
BUS 2080	Data Analysis for Decision Making	1/3
MIS 3010	Creating Value Through Innovation	1/3
MIS 3720	Business Data Management	1/3
MIS 3787	Business Applications of Machine Learning	1/3
MKT 4030	Achieving Strategic Effectiveness	1/3
OBC 3354	Organizational Behavior and Change	1/3
OBC 4367	Leadership, Ethics, and Social Responsibility	1/3
OIE 3420	Quality Planning, Design and Control	1/3

Major Qualifying Project (Minimum 3/3 Units)

The MQP should build on the student's scientific and technical concentration while articulating a problem within professional writing.

Africana Studies Minor

Degree Type

Minor

The Africana Studies Minor examines the experiences of people of African descent whether they live in Africa, the US, the Caribbean, Latin America, Europe, or Asia. The minor requirements offer an interdisciplinary approach for examining the rich cultures, arts, institutions, sciences, technologies, histories, political economies, and philosophies developed and practiced by people of African descent. The Africana Studies minor consists of two units of coursework.

Program Distribution Requirements for the Africana Studies Minor

Complete two units of coursework that meet the conditions below.

Africana Studies Core (Minimum 1/3 unit)

1/3 unit of Africana Studies Core courses

Africana Studies Core Courses

Item #	Title	Units
EN 1257	Introduction to African American Literature and Culture	1/3
HU 1400	Introduction to Africana Studies	1/3
SOC 1500	The Sociology of Race	1/3

Africana Studies Electives (Minimum 4/3 units)

4/3 units of Africana Studies Electives courses. These may be selected from any of the courses below with at least one course at the 2000-level or higher. Balance between HUA and SSPS courses is encouraged.

Africana Studies Courses

Item #	Title	Units
EN 1257	Introduction to African American Literature and Culture	1/3
EN 3257	Topics in African American Literature	1/3
HI 1345	Atlantic Worlds	1/3
HI 2345	Welcome to Paradise: the U.S. and the Caribbean	1/3
HI 2900	Topics in Gender and History	1/3
HU 1400	Introduction to Africana Studies	1/3
INTL 2410	Modern Africa	1/3
INTL 2420	Middle East, North Africa and Mediterranean	1/3
MU 2640	African Drumming Ensemble	1/3
SOC 1500	The Sociology of Race	1/3
Soc 3500	African American Political Thought	1/3

Minor Capstone (Minimum 1/3 units)

A Minor Capstone is defined as one 3000- or 4000- level class or an equivalent Undergraduate Independent Study (ISU) that culminates the minor. This course or independent study must be the final course in the sequence. HU 3900 (Inquiry Seminar) cannot count as a minor capstone.

Notes

WPI policy requires that no more than one unit of course work can be double counted toward other degree requirements. Thus, students may count three courses for the minor taken to fulfill other degree requirements (such as the Humanities and Arts requirement or the two course requirement in Social Sciences). An HUA inquiry seminar (HU 3900) primarily focused on people of African Descent may be double counted as an Africana Studies Elective.

To be counted toward the minor, a course's content must be primarily focused on people of African descent to qualify. A student may petition the Program Directors for other appropriate course(s) to be included.

HUA also offers several HU 3900 capstone Inquiry Seminars that students pursuing the minor might consider as the culminating project of their HUA Requirement. Examples of seminars that can be double counted as one of the minor courses but not as the minor capstone:

- HU 3900 The Black 60s
- HU 3900 Writing, Rhetoric, and Social Justice
- HU 3900 Black Writers of Sci-Fi Horror, and Fantasy
- HU 3900 Hip Hop
- HU 3900 Riots and Rebellion in Am Cities

NOTE: If taking MU 2640 African Drumming Ensemble, please recognize that this is a 1/6 unit for a semester work as a music ensemble - for this to work as a 1/3 unit in the unit, a student will need to take a full year of the African Drumming to earn a 1/3 unit.

American Studies Minor

Degree Type

Minor

The Minor in American Studies is for students who choose to continue their studies in a blend of American history, literature, and other fields beyond the Humanities and Arts Requirement without majoring in American Studies, English, history, or other fields in humanities and arts.

The American Studies Minor consists of a total of two units of coursework in Humanities and Arts that focus on the national experience of the United States, distributed in the following way: at least two courses in American history (List 2) and at least two in American literature (List 3), except that HUA 1411 (Introduction to American Studies) may be substituted for either an EN or an HI course. The two units comprising the American Studies Minor must include a minimum of two 3000-level courses and a maximum of one 1000-level course.

American Studies Minors may earn two-thirds-unit of credit at the 3000-level by being admitted to and completing the competitive American Antiquarian Society fall seminar, which annually accepts twelve Worcester Consortium students. Each spring, HUA faculty publicize the upcoming seminar and endorse WPI applicants. AAS seminars typically enroll two or three students from WPI.

No more than one unit of work for the Humanities and Arts Requirement may be applied toward the American Studies Minor. Any student at WPI is eligible to pursue the Minor in American Studies except for students majoring in Humanities and Arts with a concentration in American Studies.

Program Distribution Requirements for the American Studies Minor

List 1. American Antiquarian Society Fall Seminar

This competitive seminar, open to a limited number of Worcester Consortium students, features a different visiting professor and a new thematic focus each fall. The seminar is equivalent to two courses in American Studies at the 3000-level; the comparable WPI discipline(s) will be determined by the topic of each seminar. To apply, consult a member of the American Studies faculty early in the preceding D-term.

List 2. American History

Item #	Title	Units
HI 2310	Topics in Urban History	1/3
HI 2311	American Colonial History	1/3
HI 2313	American History, 1789-1877	1/3
HI 2314	American History, 1877-1920	1/3
HI 2315	The Shaping of Post-1920 America	1/3
HI 2316	Twentieth Century American Foreign Relations	1/3
HI 2318	Topics in Law, Justice and American Society	1/3
HI 2335	Topics in the History of American Science and Technology	1/3
HI 2400	Topics in Environmental History	1/3
HI 2913	Capitalism and Its Discontents	1/3
HI 2930	Topics in Latin American History	1/3
HI 3312	Topics in American Social History	1/3
HI 3314	The American Revolution	1/3
HI 3316	Topics in Twentieth-Century U.S. History	1/3
HI 3317	Topics in Environmental History	1/3
HI 3334	Topics in the History of American Science and Technology	1/3
HI 3344	Pacific Worlds	1/3

List 3. American Literature

Item #	Title	Units
EN 2234	Modern American Novel	1/3
EN 2237	Literature and the Environment	1/3
EN 2271	American Literary Histories	1/3
EN 3231	Supernatural Literatures	1/3
EN 3238	American Authors	1/3
EN 3271	American Literary Topics	1/3
ID 3531/SP 3531	Contemporary Us Latino Literature & Culture	1/3

List 4. American Art/Architecture

Item #	Title	Units
AR 2114	Modern Architecture in the American Era, 1750-2001 and Beyond	1/3

List 5. American Music

Item #	Title	Units
MU 2719	Jazz History	1/3
MU 2722	History of American Popular Music	1/3

List 6. American Philosophy and Religion

Item #	Title	Units
PY 2716/RE 2716	Gender, Race, and Class	1/3
PY 3721/RE 3721	Topics in Religion	1/3
RE 2721	Religion and Culture	1/3

For RE 2721 and PY/RE 3721, check with an American Studies advisor to determine if this course has an American focus in a given term. To facilitate degree audits by the Office of the Registrar, HUA faculty will create a form by which to approve unlisted courses that have significant focus on the U.S. national experience.

Check with an American Studies advisor to determine if RE 2721 or RE 3721 has an American focus in a given term.

List 7. American Politics, Law, and Policy

Item #	Title	Units
GOV 1301	U.S. Government	1/3
GOV 1303	American Public Policy	1/3
GOV 1310	Law, Courts, and Politics	1/3
GOV 2302	Science-Technology Policy	1/3
GOV 2310	Constitutional Law: Foundations of Government	1/3

Note:

To facilitiate degree audits by the Office of the Registrar, HUA faculty will create a form by which to approve unlisted courses that have significant focus on the U.S. national experience

Chinese Studies Minor

Degree Type

Minor

The minor in Chinese Studies offers students the opportunity to extend their study of China and the Chinese Language beyond the Humanities and Arts Requirement. The Chinese Studies minor includes intermediate or above language proficiency and content courses on Chinese history, philosophy, environmental, and society and culture. The minor is primarily intended for non-native speakers of Mandarin Chinese. Native speakers of Mandarin are not eligible to take Chinese language courses at WPI. Native speakers who wish to pursue this minor through content courses need to receive permission from the minor advisor and will most likely have to take advantage of both WPI and Consortium offerings.

WPI policy requires that no more than one unit of course work can be double counted toward other degree requirements. Thus, students may count three courses taken to fulfill other degree requirements (such as the Humanities and Arts Requirement or two course requirement in the Social Sciences) toward the minor, provided that one unit of classes taken for the minor do not double-count for another degree requirement. In practical terms, this means that up to 3/3 units from HUA Requirement and 1/3 unit from a China IQP, with a combined total from the two of no more than 3/3 unit, can be applied to the Chinese Studies minor.

A student who uses an upper level Chinese language course as the capstone for an HUA Requirement fulfilled with language courses cannot use that capstone language course as the capstone for the Chinese Studies minor. For students conducting their IQP or MQP in China, the capstone can take the form of an ISU that reflects on their onsite experiences.

Students interested in pursuing the minor should speak with Professor Jennifer Rudolph or Professor Huili Zheng to find out more and to discuss finding a capstone course and any related background courses.

Students must demonstrate a level of Chinese proficiency of at least CN 2544 or its equivalent. A total of two units (six courses) are required for the minor degree requirement from the courses listed below. These consist of:

Program Distribution Requirements for the Chinese Studies Minor

Intermediate to Advanced Chinese Language Courses (Minimum 3/3 Units)

No more than 1 unit (3 courses) of intermediate to advanced Chinese language classes chosen from the following list, or Consortium courses in Chinese approved by a WPI China faculty member.

Item #	Title	Units
CN 2542	Intermediate Chinese II	1/3
CN 2543	Intermediate Chinese III	1/3
CN 2544	Intermediate Chinese IV	1/3
CN 3541	Advanced Chinese I	1/3
CN 3542	Advanced Chinese II	1/3
CN 3543	Advanced Chinese III	1/3

Advanced Culture or Society Courses (Minimum 2/3 Units)

At least 2/3 unit (2 courses) of advanced culture or society courses chosen from the following list or Consortium courses approved by a WPI faculty member in Chinese. At least one of these must be at the 3000 level.

Item #	Title	Units
CN 3541	Advanced Chinese I	1/3
HI 2328	History of Revolutions in the Twentieth Century	1/3
HI 2343	East Asia: China at the Center	1/3
HI 3335	Topics in the History of Non-Western Science and Technology	1/3
HI 3343	Topics in Asian History	1/3
ID 2050/SS 2050	Social Science Research for the IQP	1/3
INTL 2210	Popular Culture and Social Change in Asia	1/3

Capstone Experience (Minimum 1/3 Units)

1/3 unit of capstone experience (1 course) consisting of an ISU or a 3000-level course in Chinese history, culture, literature, or philosophy identified before the beginning of the term as the capstone by the student and professor. The capstone experience must be the last course completed for the minor.

WPI current courses identified as contributing to a Chinese Studies Minor.

Chinese Language or Consortium Chinese courses in Chinese approved by a WPI China faculty member.

Item #	Title	Units
CN 1541	Elementary Chinese I	1/3
CN 1542	Elementary Chinese II	1/3
CN 1543	Elementary Chinese III	1/3
CN 2541	Intermediate Chinese I	1/3
CN 2542	Intermediate Chinese II	1/3
CN 2543	Intermediate Chinese III	1/3
CN 2544	Intermediate Chinese IV	1/3
CN 3541	Advanced Chinese I	1/3
CN 3542	Advanced Chinese II	1/3
CN 3543	Advanced Chinese III	1/3

China Content Courses

Item #	Title	Units
HI 2328	History of Revolutions in the Twentieth Century	1/3
HI 2341	Contemporaryworld Issues in Historical Perspective	1/3
HI 2343	East Asia: China at the Center	1/3
HI 3335	Topics in the History of Non-Western Science and Technology	1/3
HI 3343	Topics in Asian History	1/3
INTL 1200	Introduction to Asia	1/3
INTL 2210	Popular Culture and Social Change in Asia	1/3

Creative Writing Minor

Degree Type

Minor

The minor in creative writing includes offerings in the genres of fiction, creative nonfiction (literary journalism, memoir, personal essay), playwriting, and poetry. Creative writing combines the study of literature with the practice of artistic creation. Students will complete two literature courses and three courses in creative writing plus a capstone experience. In order to enroll in the creative writing minor, interested students should speak with one of the creative writing faculty in the Department of Humanities and Arts (Prof. Aguilar, Prof. Cocola, Prof. Ephraim, or Prof. McIntyre), complete a minor designation form, and select a minor advisor from the creative writing faculty.

The creative writing minor consists of a total of two units of course work (6/3) distributed in the following way (Note: EN2219 and EN3219 can be repeated for credit in different genres. For example, a student can take both EN2219 Creative Writing: Fiction and EN2219 Creative Writing: Poetry and count both toward the minor.):

Program Distribution Requirements for the Creative Writing Minor

Creative Writing (Minimum 3/3 Units)

Item #	Title	Units
EN 1219	Introduction to Creative Writing	1/3
EN 2219	Creative Writing	1/3
EN 3219	Advanced Creative Writing	1/3
TH 3240	Playwriting	1/3

At least three courses (one unit) in creative writing (fiction, creative nonfiction, playwriting, or poetry), including one course at the 3000 level, chosen from the provided list.

Additional Options in Consultation with Minor Advisor (no more than one of these additional courses can be used toward the Creative Writing Minor).

Item #	Title	Units
IMGD 1002	Storytelling in Interactive Media and Games	1/3
WR 2010	Elements of Style	1/3

Literature courses (Minimum 2/3 Units)

Item #	Title	Units
EN 1221/TH 1221	Introduction to Theatre on Page and Stage	1/3
EN 1222	Shakespeare in the Age of Elizabeth	1/3
EN 1242	Introduction to English Poetry	1/3
EN 1251	Introduction to Literature	1/3
EN 1257	Introduction to African American Literature and Culture	1/3
EN 1259	Introduction to Contemporary Chicana/o Literature	1/3
EN 2225	The Literature of Sin	1/3
EN 2226	Infected Shakespeare: Venereal Disease, Madness, Plague	1/3
EN 2234	Modern American Novel	1/3
EN 2237	Literature and the Environment	1/3
EN 2242	Popular Fiction: Reading in Installments	1/3
EN 2243	Modern British Literature	1/3
EN 2244	19th-Century English Literature	1/3
EN 2251	Moral Issues in the Modern Novel	1/3
EN 2252	Science and Scientists in Modern Literature	1/3
EN 2271	American Literary Histories	1/3
EN 2281	World Literatures	1/3
EN 3226	Strange and Strangers	1/3
EN 3231	Supernatural Literatures	1/3
EN 3234	Modern American Poetry	1/3
EN 3238	American Authors	1/3
EN 3248	The English Novel	1/3
EN 3257	Topics in African American Literature	1/3
EN 3271	American Literary Topics	1/3
ID 3531/SP 3531	Contemporary Us Latino Literature & Culture	1/3

At least one of which must be at the 2000 level or higher.

Capstone Experience (Minimum 1/3 Units)

Either a 1/3 unit independent study in creative writing or a 3000 level course approved by the student and advisor. The capstone course must be taken last.

English Minor

Degree Type

Minor

The minor in English is for students who choose to continue their studies in English beyond the Humanities and Arts Requirement without majoring in English. Students who, for personal or career purposes, wish to earn official recognition of their achievements in English, and who do not have academic time to fulfill the requirements for the major, should consider an English minor. Interested students should speak with one of the English faculty in the Department of Humanities and Arts.

The English minor consists of a total of two units of work in English, distributed in the following way:

Program Distribution Requirements for the English Minor

Literature Courses (Minimum 5/3 Units)

5/3 units of literature (usually EN) courses, which must include a minimum of one 3000-level course and a maximum of one 1000-level course.

1000 Level English Courses

Item #	Title	Units
EN 1219	Introduction to Creative Writing	1/3
EN 1221/TH 1221	Introduction to Theatre on Page and Stage	1/3
EN 1222	Shakespeare in the Age of Elizabeth	1/3
EN 1242	Introduction to English Poetry	1/3
EN 1251	Introduction to Literature	1/3
EN 1257	Introduction to African American Literature and Culture	1/3
EN 1259	Introduction to Contemporary Chicana/o Literature	1/3

2000 Level English Courses

Item #	Title	Units
EN 2219	Creative Writing	1/3
EN 2225	The Literature of Sin	1/3
EN 2226	Infected Shakespeare: Venereal Disease, Madness, Plague	1/3
EN 2234	Modern American Novel	1/3
EN 2237	Literature and the Environment	1/3
EN 2242	Popular Fiction: Reading in Installments	1/3
EN 2243	Modern British Literature	1/3
EN 2244	19th-Century English Literature	1/3
EN 2251	Moral Issues in the Modern Novel	1/3
EN 2252	Science and Scientists in Modern Literature	1/3
EN 2271	American Literary Histories	1/3
EN 2281	World Literatures	1/3
EN 2500/TH 2500	Fundamentals of Technical Theatre	1/3

3000 Level English Courses

Item #	Title	Units
EN 3219	Advanced Creative Writing	1/3
EN 3226	Strange and Strangers	1/3
EN 3231	Supernatural Literatures	1/3
EN 3234	Modern American Poetry	1/3
EN 3238	American Authors	1/3
EN 3248	The English Novel	1/3
EN 3257	Topics in African American Literature	1/3
EN 3271	American Literary Topics	1/3

4000 Level English Courses

English Capstone Experience (Minimum 1/3 Units)

This can be either a 1/3 unit Independent Study in English or a 3000-level course approved by the student and advisor.

3000 Level English Courses

Item #	Title	Units
EN 3219	Advanced Creative Writing	1/3
EN 3226	Strange and Strangers	1/3
EN 3231	Supernatural Literatures	1/3
EN 3234	Modern American Poetry	1/3
EN 3238	American Authors	1/3
EN 3248	The English Novel	1/3
EN 3257	Topics in African American Literature	1/3
EN 3271	American Literary Topics	1/3

Note: No more than one unit of work for the Humanities and Arts Requirement may be applied toward the English minor. Any student at WPI is eligible to pursue the Minor in English except for students majoring in Humanities and Arts with a concentration in Literature.

Gender, Sexuality & Women's Studies Minor

Degree Type

Minor

The minor in Gender, Sexuality & Women's Studies (GSWS) offers WPI students the opportunity to interrogate interlocking systems of oppression, including racism, sexism, homophobia, transphobia, classism, ethnocentrism, and colonialism, and their impact on people's lives on campus and across the world. This interdisciplinary minor combines course work from the humanities and arts, social science and policy studies, and other areas to examine issues relating to the study of gender, sexuality, and women. Interested students should speak with one of the GSWS-affiliated faculty in the Department of Humanities and Arts and/or Department of Social Science and Policy Studies, complete a minor designation form, and select a minor advisor.

The GSWS minor consists of a total of two units of course work (6/3) distributed in the following way:

Program Distribution Requirements for the Gender, Sexuality & Women's Studies Minor

Core Gender, Sexuality & Women's Studies Courses (Minimum 2/3 Units)

Students must complete 2/3 units from core Gender, Sexuality & Women's Studies courses.

Item #	Title	Units
HU 1500	Introduction to Gender, Sexuality & Women's Studies	1/3
HU 2501	STEM-inism	1/3
HU 2502	Global Feminisms	1/3

Humanities and Arts Courses (Minimum 2/3 Units)

At least two Humanities and Arts courses, at least one of which must be at the 3000 level, chosen from the following list:

Item #	Title	Units
EN 1257	Introduction to African American Literature and Culture	1/3
EN 2226	Infected Shakespeare: Venereal Disease, Madness, Plague	1/3
EN 3226	Strange and Strangers	1/3
HI 2318	Topics in Law, Justice and American Society	1/3
HI 2900	Topics in Gender and History	1/3
HU 1500	Introduction to Gender, Sexuality & Women's Studies	1/3
HU 2501	STEM-inism	1/3
HU 2502	Global Feminisms	1/3
ID 3525/SP 3525	Spanish American Film/Media: Cultural Issues	1/3
ID 3529/SP 3529	Caribbeanness: Voices of the Spanish Caribbean	1/3
INTL 2110	Global Justice	1/3
MU 2632	Alden Voices	1/3
MU 3510	Music in Time of Conflict	1/3
PY 2716/RE 2716	Gender, Race, and Class	1/3
RE 3711/PY 3711	Topics in Philosophy	1/3

Other courses, including applicable experimental courses, can be substituted with the approval of a GSWS advisor.

SSPS Courses (Minimum 1/3 Units)

Other courses, including applicable experimental courses, can be substituted with the approval of a GSWS advisor.

Item #	Title	Units
ENV 2600	Environmental Problems in the Developing World	1/3
GOV 2320	Constitutional Law: Civil Rights and Liberties	1/3
GOV 3000/PSY 3000	Psychology and Law	1/3
PSY 1402	Social Psychology	1/3
PSY 1404	Developmental Psychology	1/3
PSY 1412	Mental Health	1/3
PSY 2407	Psychology of Gender	1/3
PSY 2408	Health Psychology	1/3
PSY 2504	Human Sexuality	1/3

Note:

WPI policy requires that no more than one unit of course work can be doubled counted toward other degree requirements. In other words, students must take three courses for this minor that do not count for another degree requirement.

Global Public Health Minor

Degree Type
Minor

The minor in Global Public Health offers WPI students an opportunity to explore factors that impact the health of populations around the world. Students interested in the minor should meet with faculty associated with Global Public Health as early as possible in their academic career. They will be assigned a minor advisor after completing a minor declaration form.

The Global Public Health minor consists of two units of work distributed in the following way:

1. 2/3 unit Global Public Health Core courses from this list:
   1. STS 1200 Fundamentals of Global Health
   2. ID 2100 Disease Detectives: An Introduction to Epidemiology
   3. Or an Independent Study (ISU) approved by the Global Public Health Steering Committee
2. 3/3 unit Global Public Health Electives. 2/3 unit of these electives must be at the 2000 level or higher. These may be selected from among global public health related courses in humanities, social sciences, life sciences, engineering or business (see below). These may include:
   1. 1/3 unit Great Problems Seminar course (FY 1100) that has a Global Public Health focus and the approval of the Global Public Health Steering Committee
   2. any course listed below among Global Public Health electives or courses approved by the Global Public Health Steering Committee.
3. 1/3 unit Senior Seminar in Global Public Health (STS 4000). This seminar may be taken concurrently, or any time after a Global Public Health Experience (for example, a Global Public Health -focused IQP or MQP (see below)). With the approval of the Global Public Health Steering Committee, the seminar may be completed as an independent study.
4. Global Public Health Experience. All Global Public Health minors require an 'experience' in global public health that is educational in nature and equivalent in length to at least one WPI term. Example experiences include global public health related IQPs and MQPs, or activities such as internships, service learning or significant volunteer work accompanied by a reflective writing assignment. The Program Steering Committee Chair must approve this experience, prior to the student undertaking it, by signing the 'Global Public Health Experience Approval' at the bottom of the Application for the Global Public Health Minor.

WPI policy require that no more than one unit of course work can be double counted toward other degree requirements. Thus, students may count three courses for the minor to fulfill other degree requirements as long as one unit of the minor does not double count. In other words, students must take STS 4000 and two other courses for this minor that do not count for another degree requirement.

Global Public Health Minor Electives: Below is a list of examples of relevant courses, which students can choose from to fulfill their Global Public Health elective requirements. Students will take 1 Unit (at least 2 of the 3 courses must be at or above the 2000 level) from the list below or courses approved by the Global Public Health Steering Committee.

Social Science and Policy Study

Item #	Title	Units
GOV 2302	Science-Technology Policy	1/3
GOV 3312	International Environmental Policy	1/3
GOV 2319/ENV 2319	Global Environmental Politics	1/3
GOV 1320	Topics in International Politics	1/3
SOC 1202	Introduction to Sociology and Cultural Diversity	1/3
ECON 3125	Development Economics	1/3
PSY 1400	Introduction to Psychological Science	1/3
PSY 1402	Social Psychology	1/3
PSY 2406	Cross-Cultural Psychology: Human Behavior in Global Perspective	1/3
PSY 2407	Psychology of Gender	1/3
PSY 2408	Health Psychology	1/3

Life Sciences

Item #	Title	Units
BB 1025	Human Biology	1/3
BB 2003	Fundamentals of Microbiology	1/3
BB 3003	Medical Microbiology: Plagues of the Modern World, a Case Study Approach	1/3
BB 3920	Immunology	1/3

Humanities and Arts

Item #	Title	Units
HI 2401	U.S. Environmental History	1/3
HI 2403	Global Environmental History	1/3
INTL 1100	Introduction to International and Global Studies	1/3
PY 2712	Social and Political Philosophy	1/3
PY 2713	Bioethics	1/3
PY 2717	Philosophy and the Environment	1/3
WR 1011	Writing About Science & Technology	1/3
WR 2210	Business Writing and Communication	1/3
WR 3214	Writing About Disease & Public Health	1/3

Business

Item #	Title	Units
OBC 1010	Leadership Practice	1/3
BUS 1020	Global Environment of Business Decisions	1/3

Other

Item #	Title	Units
CE 3060	Water Treatment	1/3
CE 3061	Sustainable Wastewater Engineering: Treatment and Reuse	1/3
CE 3070	Urban and Environmental Planning	1/3
MA 2610	Applied Statistics for the Life Sciences	1/3

History Minor

Degree Type
Minor

The minor in History offers students the opportunity to extend their study of History beyond the Humanities and Arts Require- ment without majoring in History. Students who, for personal or career purposes, wish to earn official recognition of their achievements in History, and who do not have academic time to fulfill the requirements for the major, should consider the History minor. Students interested in declaring a minor should speak with one of the history faculty in the Department of Humanities and Arts. The History minor consists of a total of two units of work in history distributed as follows

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Program Distribution Requirements for the History Minor

History (HI) courses (Minimum 5/3 Units)

History (HI) courses, which must include a minimum of one 3000-level course and a maximum of one 1000-level course.

Item #	Title	Units
HI 1311	Introduction to American Urban History	1/3
HI 1313	The US and the World	1/3
HI 1314	Introduction to Early American History	1/3
HI 1322	Introduction to European History	1/3
HI 1330	Introduction to the History of Science and Technology	1/3
HI 1333	Introduction to American Histories of Protest and Power	1/3
HI 1345	Atlantic Worlds	1/3
HI 1350	Introduction to Environmental History	1/3
HI 2310	Topics in Urban History	1/3
HI 2311	American Colonial History	1/3
HI 2313	American History, 1789-1877	1/3
HI 2314	American History, 1877-1920	1/3
HI 2315	The Shaping of Post-1920 America	1/3
HI 2316	Twentieth Century American Foreign Relations	1/3
HI 2318	Topics in Law, Justice and American Society	1/3
HI 2320	Modern European History	1/3
HI 2328	History of Revolutions in the Twentieth Century	1/3
HI 2329	European Empires	1/3
HI 2335	Topics in the History of American Science and Technology	1/3
HI 2341	Contemporaryworld Issues in Historical Perspective	1/3
HI 2343	East Asia: China at the Center	1/3
HI 2345	Welcome to Paradise: the U.S. and the Caribbean	1/3
HI 2350	Topics in the History of Science	1/3
HI 2351	History of Ecology	1/3
HI 2400	Topics in Environmental History	1/3
HI 2401	U.S. Environmental History	1/3
HI 2403	Global Environmental History	1/3
HI 2900	Topics in Gender and History	1/3
HI 2913	Capitalism and Its Discontents	1/3
HI 2921	Topics in Modern European History	1/3
HI 2930	Topics in Latin American History	1/3
HI 3312	Topics in American Social History	1/3
HI 3314	The American Revolution	1/3
HI 3316	Topics in Twentieth-Century U.S. History	1/3
HI 3317	Topics in Environmental History	1/3
HI 3331	Topics in the History of European Science and Technology	1/3
HI 3333	Topics in American Technological Development	1/3
HI 3334	Topics in the History of American Science and Technology	1/3
HI 3335	Topics in the History of Non-Western Science and Technology	1/3
HI 3341	Topics in Imperial and Postcolonial History	1/3
HI 3343	Topics in Asian History	1/3
HI 3344	Pacific Worlds	1/3

History Capstone Experience (Minimum 1/3 Units)

This can be either a 1/3 unit Independent Study in History or a 3000-level HI course identified by the student and instructor as the 3000-level capstone course for the student's program. Inquiry Seminars are not eligible to count as capstone courses for the minor. The capstone course must be taken last.

3000 Level History Courses

Item #	Title	Units
HI 3312	Topics in American Social History	1/3
HI 3314	The American Revolution	1/3
HI 3316	Topics in Twentieth-Century U.S. History	1/3
HI 3317	Topics in Environmental History	1/3
HI 3331	Topics in the History of European Science and Technology	1/3
HI 3333	Topics in American Technological Development	1/3
HI 3334	Topics in the History of American Science and Technology	1/3
HI 3335	Topics in the History of Non-Western Science and Technology	1/3
HI 3341	Topics in Imperial and Postcolonial History	1/3
HI 3343	Topics in Asian History	1/3
HI 3344	Pacific Worlds	1/3

Note: No more than one unit of work for the Humanities and Arts Requirement may be applied toward the History minor. Any student at WPI is eligible to pursue the Minor in History except for students majoring in Humanities and Arts with a concentration in History.

Language (German or Spanish) Minor

Degree Type
Minor

The minor in Language can be completed in either German or Spanish. It allows students who are well prepared to continue their study of the language and its culture well beyond the advanced level. The minor consists of a total of two units of work, distributed in the following way:

Program Distribution Requirements for Language (German or Spanish) Minor

Intermediate and Advanced Language Courses in Spanish or German (Minimum 3/3 Units)

3/3 units of intermediate and advanced language courses in Spanish or German chosen from the following (or higher):

Item #	Title	Units
GN 2512	Intermediate German II: Pasts, Presents, and Futures of the German-Speaking World	1/3
GN 3511	Advanced German I: Exploration and Innovation in the German-Speaking World	1/3
SP 2522	Intermediate Spanish II	1/3
SP 3521	Advanced Spanish I	1/3
SP 3522	Advanced Spanish II	1/3

Note: This unit may be double-counted toward the Humanities and Arts Requirement. No more than one unit may be double-counted in this way.

Advanced Literature and Culture Courses (Minimum 2/3 Units)

Advanced literature and culture courses chosen from the following:

Item #	Title	Units
GN 3513	Survey of German Civilization and Culture from 1871 to the Present	1/3
GN 3514	Seminar on Selected Topics in German Literature	1/3
ID 3525/SP 3525	Spanish American Film/Media: Cultural Issues	1/3
ID 3526/SP 3526	Comparative Business Environments	1/3
SP 3523	Topics in Latin American Culture	1/3
SP 3524	Spanish-American Literature in the Twentieth Century	1/3

SP and GN courses may be substituted for Consortium courses approved by a faculty member in Spanish and German, respectively. Any 3000-level experimental course in GN or SP may also be used.

Capstone Experience (Minimum 1/3 Unit)

Capstone experience consisting of an ISU written in the foreign language.

(If, in the future, there are enough German and Spanish minors combined, the capstone independent study will be a team-taught seminar in comparative civilization/literature.) Interested students should see the following professors in the Humanities and Arts Department: Prof. Brisson (for German) or Prof. Rivera (for Spanish).

Latin American and Caribbean Studies Minor

Degree Type

Minor

The minor in Latin American and Caribbean Studies provides students with an opportunity to engage in the study of Latin America and the Caribbean beyond the Humanities and Arts Requirement. This interdisciplinary minor enables students to investigate issues and innovations that are important within Latin America and the Caribbean. It also allows students to explore topics in global studies from the perspectives of diverse groups and institutions in the region.

The Latin American and Caribbean Studies minor consists of two units of work selected from either Track One Spanish Sequence, or Track Two International and Global Studies/History Sequence. In addition to the courses listed in these two tracks, the minor advisor may approve other courses related to Latin American and Caribbean Studies, including those offered by other WPI departments and the HECCMA Consortium.

In both tracks, no more than one unit of work for the Humanities and Arts Requirement may be applied toward the Latin American and Caribbean Studies Minor. Any student at WPI is eligible to pursue the Latin American and Caribbean Studies Minor as long as at least one unit of work for these requirements does not overlap with the requirements for other minors or majors.

INTL 2910, HU 3900/3910 topics must be related to Latin America and the Caribbean

Courses that appear in Track Two list 1 and list 2 may be counted only once toward the requirements for the minor.

Track One: Spanish Sequence

3/3 units selected from the following courses:

Item #	Title	Units
SP 3523	Topics in Latin American Culture	1/3
SP 3524	Spanish-American Literature in the Twentieth Century	1/3
SP 3533	Ecocrítica: Environmental Cultural Production in Latin America	1/3
SP 3534	Intersections of Science, Engineering, Art, Literature, and Film in Latin America and the Caribbean	1/3

3/3 units selected from among the following:

Item #	Title	Units
DEV 1200	International Development and Society	1/3
DEV 2200	Case Studies in International Development Policy and Engineering	1/3
EN 1259	Introduction to Contemporary Chicana/o Literature	1/3
ENV 2600	Environmental Problems in the Developing World	1/3
GOV 2319/ENV 2319	Global Environmental Politics	1/3
HI 1313	The US and the World	1/3
HI 1345	Atlantic Worlds	1/3
HI 2316	Twentieth Century American Foreign Relations	1/3
HI 2328	History of Revolutions in the Twentieth Century	1/3
HI 2345	Welcome to Paradise: the U.S. and the Caribbean	1/3
HI 2930	Topics in Latin American History	1/3
HU 3900	Inquiry Seminar in Humanities and Arts	1/3
HU 3910	Practicum in Humanities and Arts	1/3
INTL 1100	Introduction to International and Global Studies	1/3
INTL 1300	Introduction to Latin America	1/3
INTL 2100	Approaches to Global Studies	1/3
INTL 2310	Modern Latin America	1/3
INTL 2320	Environmental Justice in the Global Caribbean and Latin America	1/3
INTL 2910	Topics in Global Studies	1/3
PY 2716/RE 2716	Gender, Race, and Class	1/3

Track Two: International and Global Studies/History Sequence

3/3 unit selected from the following courses:

Item #	Title	Units
HI 1345	Atlantic Worlds	1/3
HI 2930	Topics in Latin American History	1/3
HU 3900	Inquiry Seminar in Humanities and Arts	1/3
HU 3910	Practicum in Humanities and Arts	1/3
INTL 1100	Introduction to International and Global Studies	1/3
INTL 1300	Introduction to Latin America	1/3
INTL 2310	Modern Latin America	1/3

3/3 unit selected from among the following:

Item #	Title	Units
DEV 1200	International Development and Society	1/3
DEV 2200	Case Studies in International Development Policy and Engineering	1/3
EN 1259	Introduction to Contemporary Chicana/o Literature	1/3
ENV 2600	Environmental Problems in the Developing World	1/3
GOV 2319/ENV 2319	Global Environmental Politics	1/3
HI 1313	The US and the World	1/3
HI 1345	Atlantic Worlds	1/3
HI 2316	Twentieth Century American Foreign Relations	1/3
HI 2328	History of Revolutions in the Twentieth Century	1/3
HI 2345	Welcome to Paradise: the U.S. and the Caribbean	1/3
HI 2930	Topics in Latin American History	1/3
HI 3341	Topics in Imperial and Postcolonial History	1/3
HU 3900	Inquiry Seminar in Humanities and Arts	1/3
HU 3910	Practicum in Humanities and Arts	1/3
INTL 1100	Introduction to International and Global Studies	1/3
INTL 1300	Introduction to Latin America	1/3
INTL 2100	Approaches to Global Studies	1/3
INTL 2310	Modern Latin America	1/3
INTL 2320	Environmental Justice in the Global Caribbean and Latin America	1/3
INTL 2910	Topics in Global Studies	1/3
PY 2716/RE 2716	Gender, Race, and Class	1/3
SP 3523	Topics in Latin American Culture	1/3
SP 3524	Spanish-American Literature in the Twentieth Century	1/3
SP 3533	Ecocrítica: Environmental Cultural Production in Latin America	1/3
SP 3534	Intersections of Science, Engineering, Art, Literature, and Film in Latin America and the Caribbean	1/3

Media Arts Minor

Degree Type

Minor

The Media Arts minor is for students who have a serious interest in multimedia and digital art. The Media Art minor includes a series of courses in visual and graphic arts, animation/film/ video, audio arts, critical studies of art, and art history.

Students interested in pursuing the minor should speak with an HUA advisor about the rules of pursuing the minor, as well as finding a capstone course and any related background courses.

A total of six courses are required for the minor degree requirement. These consist of:

Program Distribution Requirements for the Media Arts Minor

Visual Art Production (Minimum 3/3 Units)

Students must complete 3/3 units (3 courses) in visual art production (List 1)

List 1: Visual Art Production

Item #	Title	Units
AR 2301	Graphic Design	1/3
AR 2333/IMGD 2333	3D Animation I	1/3
AR 2401	Video Production	1/3
AR 2700/IMGD 2700	Digital Painting	1/3
AR 3101/IMGD 3101	3D Modeling II	1/3
AR 3200/IMGD 3200	Interactive Electronic Arts	1/3
AR 3222/IMGD 3222	2D Animation II	1/3
AR 3333/IMGD 3333	3D Animation II	1/3
AR 3700/IMGD 3700	Concept Art and Creative Illustration	1/3
IMGD 3500	Artistic Game Development I	1/3
IMGD 4500	Artistic Game Development II	1/3

Visual Art Production, Critical Studies in Art, or Audio Arts Directly Related to Digital Media Production (Minimum 1/3 Units)

1/3 Unit (1 course) in either visual art production (List 1), critical studies in art (List 2), or audio arts directly related to digital media production (List 3).

List 1: Visual Art Production

Item #	Title	Units
AR 2301	Graphic Design	1/3
AR 2333/IMGD 2333	3D Animation I	1/3
AR 2401	Video Production	1/3
AR 2700/IMGD 2700	Digital Painting	1/3
AR 3101/IMGD 3101	3D Modeling II	1/3
AR 3200/IMGD 3200	Interactive Electronic Arts	1/3
AR 3222/IMGD 3222	2D Animation II	1/3
AR 3333/IMGD 3333	3D Animation II	1/3
AR 3700/IMGD 3700	Concept Art and Creative Illustration	1/3
IMGD 3500	Artistic Game Development I	1/3
IMGD 4500	Artistic Game Development II	1/3

List 2: Critical Studies in Art

Item #	Title	Units
GN 3516	German Film	1/3
HU 2251	Introduction to Film Studies	1/3
ID 3530/SP 3530	Spanish Film/Media: Cultural Issues	1/3
IMGD 1000	Critical Studies of Interactive Media and Games	1/3
IMGD 2001	Philosophy and Ethics of Computer Games	1/3
WR 2310	Visual Rhetoric	1/3

List 3: Audio Arts

Item #	Title	Units
IMGD 2030	Game Audio I	1/3
IMGD 3030	Game Audio II	1/3
MU 2300	Foundations of Music Technology	1/3
MU 2801	Making Music with Machines	1/3
MU 3614	Topics in Midi	1/3
MU 3615	Topics in Digital Sound	1/3
MU 3616	Topics in Interactive Programming	1/3
MU 3620	Electronic Music Composition	1/3

Art History (Minimum 1/3 Units)

Students must complete 1/3 units (1 course) in Art History (List 4).

List 4: Art History

Item #	Title	Units
AR 1111	Introduction to Art History	1/3
AR 2111	Modern Art	1/3
AR 2114	Modern Architecture in the American Era, 1750-2001 and Beyond	1/3
AR 3112	Modernism, Mass Culture, and the Avant-Garde	1/3
AR 3150/ID 3150	Light, Vision and Understanding	1/3
HU 2251	Introduction to Film Studies	1/3
IMGD 4200	History and Future of Immersive and Interactive Media	1/3

Capstone Experience (Minimum 1/3 Units)

3000 or higher level visual art course as a final capstone experience.

List 5: 3000 Level Capstone Courses

Item #	Title	Units
AR 3101/IMGD 3101	3D Modeling II	1/3
AR 3200/IMGD 3200	Interactive Electronic Arts	1/3
AR 3222/IMGD 3222	2D Animation II	1/3
AR 3333/IMGD 3333	3D Animation II	1/3
AR 3700/IMGD 3700	Concept Art and Creative Illustration	1/3
IMGD 3500	Artistic Game Development I	1/3
IMGD 4500	Artistic Game Development II	1/3

Note: WPI minor rules apply in that no more than three courses can be double-counted for any other degree requirement. Any student at WPI is eligible to pursue the minor in Media Arts except for students majoring in IMGD with a concentration in Art.

Music Minor

Degree Type

Minor

The Minor in Music is for students who choose to continue their studies in Music beyond the Humanities and Arts Requirement without pursuing a Concentration in Music. Students who, for personal or career purposes, wish to achieve official recognition of their achievements in Music, yet do not find the time to fulfill the requirements for the Concentration, should consider the Music Minor option. The Music Minor consists of two units of work distributed as follows:

Program Distribution Requirements for the Music Minor

Music (Minimum 5/3 Units)

Students must complete 5/3 units of music courses.

Item #	Title	Units
MU 1511	Introduction to Music	1/3
MU 1611	Fundamentals of Music I	1/3
MU 2300	Foundations of Music Technology	1/3
MU 2501/PSY 2501	Music and Mind	1/3
MU 2611	Fundamentals of Music II	1/3
MU 2631	Glee Club	1/3
MU 2632	Alden Voices	1/3
MU 2633	Brass Ensemble	1/3
MU 2636	Concert Band	1/3
MU 2637	Orchestra	1/3
MU 2638	Chamber Choir	1/3
MU 2639	String Quartet	1/3
MU 2640	African Drumming Ensemble	1/3
MU 2641	Percussion Ensemble	1/3
MU 2642	Jazz Combo	1/3
MU 2643	Jazz Ensemble	1/3
MU 2644	Stage Band	1/3
MU 2719	Jazz History	1/3
MU 2720	Music History I: Medieval Through the Baroque	1/3
MU 2721	Music History II: Classical to the Present	1/3
MU 2722	History of American Popular Music	1/3
MU 2723	Music Composition	1/3
MU 2801	Making Music with Machines	1/3
MU 3001	World Music	1/3
MU 3002	Arranging and Orchestration	1/3
MU 3510	Music in Time of Conflict	1/3
MU 3614	Topics in Midi	1/3
MU 3615	Topics in Digital Sound	1/3
MU 3616	Topics in Interactive Programming	1/3
MU 3620	Electronic Music Composition	1/3
MU 3730	Jazz Theory	1/3
MU 4621	Independent Instruction (Lessons) in Music	1/3

1000 Level Music Courses

Item #	Title	Units
MU 1511	Introduction to Music	1/3
MU 1611	Fundamentals of Music I	1/3

2000 Level Music Courses

Item #	Title	Units
MU 2300	Foundations of Music Technology	1/3
MU 2501/PSY 2501	Music and Mind	1/3
MU 2611	Fundamentals of Music II	1/3
MU 2631	Glee Club	1/3
MU 2632	Alden Voices	1/3
MU 2633	Brass Ensemble	1/3
MU 2636	Concert Band	1/3
MU 2637	Orchestra	1/3
MU 2638	Chamber Choir	1/3
MU 2639	String Quartet	1/3
MU 2640	African Drumming Ensemble	1/3
MU 2641	Percussion Ensemble	1/3
MU 2642	Jazz Combo	1/3
MU 2643	Jazz Ensemble	1/3
MU 2644	Stage Band	1/3
MU 2719	Jazz History	1/3
MU 2720	Music History I: Medieval Through the Baroque	1/3
MU 2721	Music History II: Classical to the Present	1/3
MU 2722	History of American Popular Music	1/3
MU 2723	Music Composition	1/3
MU 2801	Making Music with Machines	1/3

3000 Level Music Courses

Item #	Title	Units
MU 3001	World Music	1/3
MU 3002	Arranging and Orchestration	1/3
MU 3510	Music in Time of Conflict	1/3
MU 3614	Topics in Midi	1/3
MU 3615	Topics in Digital Sound	1/3
MU 3616	Topics in Interactive Programming	1/3
MU 3620	Electronic Music Composition	1/3
MU 3730	Jazz Theory	1/3

4000 Level Music Courses

Item #	Title	Units
MU 4621	Independent Instruction (Lessons) in Music	1/3

Music Ensembles

Item #	Title	Units
MU 2631	Glee Club	1/3
MU 2632	Alden Voices	1/3
MU 2633	Brass Ensemble	1/3
MU 2636	Concert Band	1/3
MU 2637	Orchestra	1/3
MU 2638	Chamber Choir	1/3
MU 2639	String Quartet	1/3
MU 2643	Jazz Ensemble	1/3
MU 2644	Stage Band	1/3

Students may receive no more than 2/3 units from Music Ensembles.

Capstone Experience (Minimum 1/3 Units)

1/3 unit ISU as a final capstone experience. Students, with faculty guidance, will complete a project which could consist of a paper, composition, arrangement, performance, or other project designed in consultation with the faculty advisor.

Note:

If a student completes the Humanities and Arts Requirement in music 1 unit of that work may be applied to the minor except the final Seminar or Practicum.

A student who is pursuing a Major in Humanities and Arts with Music as the Concentration cannot also receive a Minor in Music.

Philosophy and Religion Minor

Degree Type

Minor

A Philosophy and Religion Minor requires completion of 2 units of work in Philosophy and Religion distributed as follows:

Program Distribution Requirements for the Philosophy and Religion Minor

Philosophy and/or Religion (Minimum 5/3 Units)

5/3 unit of PY and/or RE courses, which must include a minimum of one 3000-level course and a maximum of one 1000-level course.

Item #	Title	Units
PY 1731/RE 1731	Introduction to Philosophy and Religion	1/3
PY 2711	Epistemology	1/3
PY 2712	Social and Political Philosophy	1/3
PY 2713	Bioethics	1/3
PY 2716/RE 2716	Gender, Race, and Class	1/3
PY 2717	Philosophy and the Environment	1/3
PY 2718	Existentialism and Phenomenology	1/3
PY 2719	Philosophy of Science	1/3
PY 2731/RE 2731	Ethics	1/3
PY 2734	Philosophy and Spirituality	1/3
PY 3712	Philosophy of Religion	1/3
PY 3721/RE 3721	Topics in Religion	1/3
RE 2721	Religion and Culture	1/3
RE 2722	Modern Problems of Belief	1/3
RE 2725	Religious and Spiritual Traditions	1/3
RE 3711/PY 3711	Topics in Philosophy	1/3
RE 3723	Religion, Gender & Sexuality	1/3

Capstone Experience (Minimum 1/3 Unit)

1/3 unit Philosophy and Religion Capstone Experience. This can be either a 1/3 unit Independent Study in Philosophy and Religion or a 2000 or 3000-level course approved by the student and advisor, to which significant extra reading and writing requirements are added. The capstone course must be taken last.

Note: No more than one unit of work from the Humanities and Arts Requirement may be applied toward the Philosophy and Religion minor. The Inquiry Seminar Project cannot be applied to the Minor. Any student at WPI is eligible to pursue the minor in Philosophy and Religion except for students majoring in Humanities and Arts with a concentration in philosophy.

Sustainability Engineering Minor

Degree Type
Minor

This academic minor is intended for students who are interested in gaining knowledge and experience in the principles and practices of engineering design for sustainability, and of the critical role of engineering decisions on the sustainability of the resulting designs. Every engineering discipline impacts the environmental and social sustainability of our planet, and knowledge of the principles of sustainability in engineering design will contribute substantially to professional practice.

While this minor is intended primarily for engineering students, it is open to all students. For non-engineering students the expected background courses may increase the total minor program to more than two units.

Requirements: Candidates for the Sustainability Engineering Minor must meet the following requirements:

1. Complete and obtain approval for the Application for the Minor in Sustainability Engineering available from the Registrar or the Office of Sustainability.
    1. Define a focus for the minor. Some examples are given below but these are not comprehensive. Note that the focus must be distinct from the content of your major and must be supported by the courses in the minor.
    2. List the academic activities that will be included in the minor, following the general rules for minors at WPI as well as the rules below.
2. Complete two units of work for the minor, one unit of which may be double counted with other degree requirements. The two units must meet the requirements listed below.
3. To accommodate new sustainability-related courses and independent study and project activities, up to two thirds units may be substituted for the activities listed in items III and IV with the approval of the Sustainability Engineering Minor program review committee. This committee may be contacted through the Registrar or the Director of Sustainability.
4. See the WPI Undergraduate Catalog for additional rules for all minors, in particular that the MQP cannot be used in satisfying any Minor and that at most one unit may be double counted with another degree requirement.

Two Units for the Minor

Complete two units of work for the minor, one unit of which may be double counted with other degree requirements.The two units must meet the following requirements:

I. Must include

Item #	Title	Units
ES 2800	Environmental Impacts of Engineering Decisions	1/3

II. May include at most 1/3 U of relevant 1000-level work from the following list (List A):

Item #	Title	Units
	ENV 1100 or Relevant GPS FY 1100 Credit	1/3

III. Must include 2/3 U of relevant Humanities, Business, and/or SSPS work selected from the following list (List B):

Item #	Title	Units
DEV 2200	Case Studies in International Development Policy and Engineering	1/3
DEV 4400	Science, Engineering and Design in International Development	1/3
ECON 3117	Environmental Economics	1/3
ECON 3125	Development Economics	1/3
ENV 2201	Planning for Sustainable Communities	1/3
ENV 2310	Environmental Governance and Innovation	1/3
ENV 2600	Environmental Problems in the Developing World	1/3
ENV 2700	Social Media, Social Movements, and the Environment	1/3
ENV 3100	Adventures in Sustainable Urbanism	1/3
ENV 4400	Senior Seminar in Environmental Studies	1/3
ETR 2900	Social Entrepreneurship	1/3
GOV 2311	Environmental Policy and Law	1/3
GOV 3312	International Environmental Policy	1/3
GOV 2319/ENV 2319	Global Environmental Politics	1/3
STS 1200	Fundamentals of Global Health	1/3
STS 4000	Senior Seminar in Global Public Health	1/3
HI 2400	Topics in Environmental History	1/3
HI 3317	Topics in Environmental History	1/3
OBC 4367	Leadership, Ethics, and Social Responsibility	1/3
PY 2717	Philosophy and the Environment	1/3

IV. Must include at least 2/3 U of engineering work from the following list (List C):

Note – the course selections from Item IV cannot include more than one ES course.

Item #	Title	Units
AREN 3003	Principles of HVAC Design for Buildings	1/3
AREN 3020	Architectural Design IV - Building Energy Simulation	1/3
AREN 3024	Building Physics	1/3
CHE 3702	Energy Challenges in the 21st Century	1/3
CHE 3722	Bioenergy	1/3
CE 3059	Environmental Engineering	1/3
CE 3060	Water Treatment	1/3
CE 3061	Sustainable Wastewater Engineering: Treatment and Reuse	1/3
CE 3062	Hydraulics	1/3
CE 3070	Urban and Environmental Planning	1/3
CE 3074	Environmental Analysis	1/3
CE 4061	Hydrology	1/3
CE 4600	Hazardous and Industrial Waste Management	1/3
ECE 3500	Electric Power and Renewable Energy Systems	1/3
ES 2001	Introduction to Materials Science	1/3
ES 3001	Introduction to Thermodynamics	1/3
ES 3002	Mass Transfer	1/3
ES 3003	Heat Transfer	1/3
ES 3004	Fluid Mechanics	1/3
ME 2820	Materials Processing	1/3
ME 4422	Design and Optimization of Thermal Systems	1/3
ME 4429	Thermofluid Application and Design	1/3
ME 5105	Renewable Energy	1/3

Guidance for Students

Possible Focus Areas (not exhaustive):

The following focus areas and sample programs may be helpful in selecting the activities that compose the two units of credit for the minor, but they are not meant be restrictive in any way.

- Sustainable Engineering in the Developing World
- Engineering Design for Sustainability
- Sustainable Manufacturing
- Clean and Renewable Energy
- Sustainable Engineering Materials
- Resource Recovery and Reuse
- Green Buildings

Example Programs

Clean and Renewable Energy
- FY 1100, Power the World
- ES 2800, Environmental Impacts of Engineering Decisions
- CHE 3702, Energy Challenges of the 21st Century
- AREN 3025, Building Energy Simulation
- ENV 2201, Planning for Sustainable Communities
- ENV 2600 Environmental Problems in the Developing World

Engineering Design for Sustainability
- FY 1100, Recover, Reuse, and Recycle: Building a Lasting World
- ES 2800, Environmental Impacts of Engineering Decisions
- CE 3059, Environmental Engineering
- AREN 3025, Building Energy Simulation
- ENV 2600, Environmental Problems in the Developing World
- CE 3070, Urban and Environmental Planning

Sustainable Engineering in the Developing World
- ES 2800, Environmental Impacts of Engineering Decisions
- ENV 2600, Environmental Problems in the Developing World
- ETR 2900, Social Entrepreneurship
- CE 3070, Urban and Environmental Planning
- ECE 3500, Introduction to Contemporary Electric Power Systems
- GOV 2319, Global Environmental Politics

Green Buildings (Focus not available to Architectural Engineering students)
- ES 2800, Environmental Impacts of Engineering Decisions
- GOV 2311, Environmental Policy and Law
- ETR 2900, Social Entrepreneurship
- AREN 3003, Principles of HVAC Design for Buildings
- AREN 3024, Building Physics
- CE 3070, Urban and Environmental Planning

Theatre Minor

Degree Type
Minor

The Theatre minor offers students the opportunity to deepen their understanding of the field through classroom- and production-based theatre experiences, culminating in a significant research project.

Because both classroom learning and practical experience are integral to the study of theatre, the Theatre minor requires both academic and production work.

The Theatre minor consists of 2 units of work distributed as follows:

Program Distribution Requirements for the Theatre Minor

Theatre Courses (Minimum 2/3 Units)

2/3 units of non-production TH or theatre-related courses (including those listed below).

Non-Production Theatre Courses

Item #	Title	Units
EN 1221/TH 1221	Introduction to Theatre on Page and Stage	1/3
EN 2500/TH 2500	Fundamentals of Technical Theatre	1/3
TH 2100	Fundamentals of Acting	1/3
TH 2400	Fundamentals of Theatrical Design	1/3
TH 3200	Special Topics in Dramatic Literature	1/3
TH 3240	Playwriting	1/3
TH 3300	Special Topics in Performance Studies	1/3
TH 3510	Scenic Fabrication	1/3

Theatre-related Courses

Item #	Title	Units
EN 1222	Shakespeare in the Age of Elizabeth	1/3
EN 2226	Infected Shakespeare: Venereal Disease, Madness, Plague	1/3

Theatre Productions (Minimum 1/3 Units)

1/3 unit of credited theatrical production work (TH 1800 or TH 2800).

Item #	Title	Units
TH 1800	Club Theatre Production	1/6
TH 2800	Departmental Theatre Production	1/3

Theatre Electives (Minimum 2/3 Units)

2/3 units of TH electives (classes and/or credited theatrical production work).

Theatre Capstone Experience (Minimum 1/3 Units) (TH 3800)

A 1/3 unit research project, supervised by a faculty member (typically completed as part of a departmental production)

Note:

No more than 3/3 unit of work for the Humanities and Arts Requirement may be applied to the Theatre minor. The final Inquiry Seminar or Practicum may not be counted toward the minor.

Any student at WPI is eligible to pursue the Minor in Theatre except for students majoring in Humanities and Arts with a concentration in Theatre.

Writing and Rhetoric Minor

Degree Type

Minor

The minor in Writing and Rhetoric offers students the opportunity to extend their study of writing and rhetoric beyond the Humanities and Arts Requirement without majoring in either the Writing and Rhetoric concentration in Humanities and Arts or the interdisciplinary Professional Writing program. Students interested in declaring a minor should obtain a minor declaration form so that they are assigned an advisor early in the process. Contact the Director of Professional Writing for more information. The minor consists of two units of work, distributed in the following way:

Program Distribution Requirements for Writing and Rhetoric Minor

Core Course in Writing and Rhetoric (Minimum 1/3 Units)

Core course in Writing and Rhetoric: WR 3112 or equivalent.

Item #	Title	Units
WR 3112	Rhetorical Theory	1/3

Electives in Writing and Rhetoric (Minimum 4/3 Units)

Electives in writing and rhetoric (WR). If there is good reason, and with the approval of the Program Review Committee, electives may also include courses in art history, literature (in English or other languages), and philosophy and religion.

Item #	Title	Units
AB 1533	Elementary Arabic III	1/3
IMGD 2450/WR 2450	Narrative Design for Interactive Media and Games	1/3
IMGD 3450/WR 3450	Writing Characters for Interactive Media & Games	1/3
WR 1010	Elements of Writing	1/3
WR 1011	Writing About Science & Technology	1/3
WR 1020	Introduction to Rhetoric	1/3
WR 2010	Elements of Style	1/3
WR 2210	Business Writing and Communication	1/3
WR 2310	Visual Rhetoric	1/3
WR 2500	Writing in the Life Sciences	1/3
WR 3011	Teaching Writing	1/3
WR 3112	Rhetorical Theory	1/3
WR 3210	Technical Writing	1/3
WR 3214	Writing About Disease & Public Health	1/3
WR 3300	Cross-Cultural Communication	1/3
WR 4111	Research Methods in Writing	1/3
WR 4210	Medical Writing	1/3

Capstone Course or Experience (Minimum 1/3 Units)

Capstone course WR 4111 unless an Independent Study (ISU) substitution is authorized by the student's program review committee, and will be granted only under unusual circumstances. Should students receive permission to complete the capstone with an ISU, then those students should submit and have approved a one-page proposal for their capstone to the Program Review Committee the term before they intend to complete it.

Item #	Title	Units
WR 4111	Research Methods in Writing	1/3

Note:

No more than 1 unit of course work may be double-counted toward the Humanities and Arts Requirement. Students interested in this area also may wish to consider the major in Professional Writing (see catalog rules for minors).

Humanities and Arts Major with Concentration in Art

Degree Type

Concentration

Program Distribution Requirements for Humanities and Arts with Art Concentration

Art and/or Humanities Requirement (Minimum 2 Units)

Students will complete 2 units of course work in art (AR) or humanities and arts (HU)

All Art Courses

Item #	Title	Units
AR 1100	Essentials of Art	1/3
AR 1101	Digital Imaging and Computer Art	1/3
AR 1111	Introduction to Art History	1/3
AR 2048/IMGD 2048	Technical Art and Character Rigging	1/3
AR 2101/IMGD 2101	3D Modeling I	1/3
AR 2111	Modern Art	1/3
AR 2114	Modern Architecture in the American Era, 1750-2001 and Beyond	1/3
AR 2115	Topics in Architecture Since 1960	1/3
AR 2202	Figure Drawing	1/3
AR 2222/IMGD 2222	2D Animation I	1/3
AR 2301	Graphic Design	1/3
AR 2333/IMGD 2333	3D Animation I	1/3
AR 2401	Video Production	1/3
AR 2700/IMGD 2700	Digital Painting	1/3
AR 2740/IMGD 2740	3D Environmental Modeling	1/3
AR 2750	Topics in Studio Art	1/3
AR 3101/IMGD 3101	3D Modeling II	1/3
AR 3112	Modernism, Mass Culture, and the Avant-Garde	1/3
AR 3150/ID 3150	Light, Vision and Understanding	1/3
AR 3200/IMGD 3200	Interactive Electronic Arts	1/3
AR 3210/IMGD 3210	Human Figure in Motion	1/3
AR 3222/IMGD 3222	2D Animation II	1/3
AR 3333/IMGD 3333	3D Animation II	1/3
AR 3700/IMGD 3700	Concept Art and Creative Illustration	1/3

All Humanities Courses

Item #	Title	Units
EN 1259	Introduction to Contemporary Chicana/o Literature	1/3
HU 1222	Introduction to Medical Humanities	1/3
HU 1400	Introduction to Africana Studies	1/3
HU 1411	Introduction to American Studies	1/3
HU 1500	Introduction to Gender, Sexuality & Women's Studies	1/3
HU 2222	Topics in Medical Humanities	1/3
HU 2251	Introduction to Film Studies	1/3
HU 2258	World Cinemas	1/3
HU 2501	STEM-inism	1/3
HU 2502	Global Feminisms	1/3
HU 2900	Humanities and Arts Project Preparation	1/6
HU 2901	Topics in Sexuality and LGBTQ+ Studies	1/3
HU 2910	Project Center Experiential Learning	1/3
HU 3900	Inquiry Seminar in Humanities and Arts	1/3
HU 3910	Practicum in Humanities and Arts	1/3
TH 1800	Club Theatre Production	1/6
TH 2400	Fundamentals of Theatrical Design	1/3
TH 2800	Departmental Theatre Production	1/3

MQP in Art (Minimum 3/3 Units)

Humanities and Arts Major with Concentration in Environmental Studies

Degree Type
Concentration

This interdisciplinary concentration combines course work from the humanities and arts, social sciences, and other areas to examine environmental issues

Program Distribution Requirements for Humanities and Arts with Environmental Studies Concentration

Designated Environmental Courses in Humanities (Minimum 3/3 Units)

Students must complete 3/3 units from List 1 ("Designated Environmental Courses in Humanities").

Item #	Title	Units
AR 2114	Modern Architecture in the American Era, 1750-2001 and Beyond	1/3
EN 2237	Literature and the Environment	1/3
HI 1311	Introduction to American Urban History	1/3
HI 1350	Introduction to Environmental History	1/3
HI 2310	Topics in Urban History	1/3
HI 2400	Topics in Environmental History	1/3
HI 3317	Topics in Environmental History	1/3
HI 3331	Topics in the History of European Science and Technology	1/3
HI 3335	Topics in the History of Non-Western Science and Technology	1/3
HI 3344	Pacific Worlds	1/3
INTL 1100	Introduction to International and Global Studies	1/3
PY 2712	Social and Political Philosophy	1/3
PY 2713	Bioethics	1/3
PY 2717	Philosophy and the Environment	1/3
PY 2719	Philosophy of Science	1/3
PY 2731/RE 2731	Ethics	1/3

Related Environmental Courses in Social Sciences (Minimum 2/3 Units)

Students must complete 2/3 units from List 2 ("Related Environmental Courses in Social Sciences")

Item #	Title	Units
DEV 1200	International Development and Society	1/3
DEV 2200	Case Studies in International Development Policy and Engineering	1/3
ECON 3117	Environmental Economics	1/3
ECON 3125	Development Economics	1/3
ENV 1100	Introduction to Environmental Studies	1/3
ENV 2201	Planning for Sustainable Communities	1/3
ENV 2310	Environmental Governance and Innovation	1/3
ENV 2600	Environmental Problems in the Developing World	1/3
ENV 2700	Social Media, Social Movements, and the Environment	1/3
ENV 2900	The Green Economy and Models for Alternative ForMS of Development	1/3
ENV 3100	Adventures in Sustainable Urbanism	1/3
ENV 4400	Senior Seminar in Environmental Studies	1/3
GOV 3312	International Environmental Policy	1/3

Environmental Courses in Other Areas (Minimum 1/3 Units)

Students must complete 1/3 units from List 3 ("Environmental Courses in Other Areas")

Item #	Title	Units
BB 2040	Principles of Ecology	1/3
CE 3059	Environmental Engineering	1/3
CE 3070	Urban and Environmental Planning	1/3
CE 3074	Environmental Analysis	1/3
CE 4060	Environmental Engineering Laboratory	1/3
CE 4063/CHE 4063	Transport & Transformations in the Environment	1/3
CHE 3702	Energy Challenges in the 21st Century	1/3
ES 2800	Environmental Impacts of Engineering Decisions	1/3

MQP in Environmental Studies (Minimum 3/3 Units)

Humanities and Arts Major with Concentration in German Studies

Degree Type

Concentration

Program Distribution Requirements for Humanities and Arts German Studies Concentration

German Requirement (Minimum 6/3 Units)

Students will complete 6/3 units of German (GN) at the 2000 level or higher

Item #	Title	Units
GN 2511	Intermediate German I: Cultural Practices and Products of the German-Speaking World	1/3
GN 2512	Intermediate German II: Pasts, Presents, and Futures of the German-Speaking World	1/3
GN 3511	Advanced German I: Exploration and Innovation in the German-Speaking World	1/3
GN 3512	Advanced German II: National Identities and Stories	1/3
GN 3513	Survey of German Civilization and Culture from 1871 to the Present	1/3
GN 3514	Seminar on Selected Topics in German Literature	1/3
GN 3516	German Film	1/3

MQP in German Studies (Minimum 3/3 Units)

Humanities and Arts Major with Concentration in Hispanic Studies

Degree Type

Concentration

Program Distribution Requirements for Humanities and Arts with Hispanic Studies Concentration

Spanish Courses (Minimum 6/3 Units)

Students will complete 2 units in Spanish (SP) at the 2000 level or higher

Item #	Title	Units
ID 3525/SP 3525	Spanish American Film/Media: Cultural Issues	1/3
ID 3526/SP 3526	Comparative Business Environments	1/3
ID 3527/SP 3527	Technical and Business Spanish	1/3
ID 3529/SP 3529	Caribbeanness: Voices of the Spanish Caribbean	1/3
ID 3530/SP 3530	Spanish Film/Media: Cultural Issues	1/3
ID 3531/SP 3531	Contemporary Us Latino Literature & Culture	1/3
SP 2521	Intermediate Spanish I	1/3
SP 2522	Intermediate Spanish II	1/3
SP 3521	Advanced Spanish I	1/3
SP 3522	Advanced Spanish II	1/3
SP 3523	Topics in Latin American Culture	1/3
SP 3524	Spanish-American Literature in the Twentieth Century	1/3
SP 3528	Spanish Culture and Civilization	1/3
SP 3532	Studies in Spanish Literature: Artistic Expression and Nation Building	1/3
SP 3533	Ecocrítica: Environmental Cultural Production in Latin America	1/3
SP 3534	Intersections of Science, Engineering, Art, Literature, and Film in Latin America and the Caribbean	1/3

MQP in Spanish (Minimum 3/3 Units)

Humanities and Arts Major with Concentration in History

Degree Type

Concentration

Program Distribution Requirements for Humanities and Arts with History Concentration

History Courses (Minimum 6/3 Units)

Students will complete 6/3 units of History at the 2000 level or higher.

Item #	Title	Units
HI 2310	Topics in Urban History	1/3
HI 2311	American Colonial History	1/3
HI 2313	American History, 1789-1877	1/3
HI 2314	American History, 1877-1920	1/3
HI 2315	The Shaping of Post-1920 America	1/3
HI 2316	Twentieth Century American Foreign Relations	1/3
HI 2318	Topics in Law, Justice and American Society	1/3
HI 2320	Modern European History	1/3
HI 2328	History of Revolutions in the Twentieth Century	1/3
HI 2329	European Empires	1/3
HI 2335	Topics in the History of American Science and Technology	1/3
HI 2341	Contemporaryworld Issues in Historical Perspective	1/3
HI 2343	East Asia: China at the Center	1/3
HI 2345	Welcome to Paradise: the U.S. and the Caribbean	1/3
HI 2350	Topics in the History of Science	1/3
HI 2351	History of Ecology	1/3
HI 2400	Topics in Environmental History	1/3
HI 2401	U.S. Environmental History	1/3
HI 2403	Global Environmental History	1/3
HI 2900	Topics in Gender and History	1/3
HI 2913	Capitalism and Its Discontents	1/3
HI 2921	Topics in Modern European History	1/3
HI 2930	Topics in Latin American History	1/3
HI 3312	Topics in American Social History	1/3
HI 3314	The American Revolution	1/3
HI 3316	Topics in Twentieth-Century U.S. History	1/3
HI 3317	Topics in Environmental History	1/3
HI 3331	Topics in the History of European Science and Technology	1/3
HI 3333	Topics in American Technological Development	1/3
HI 3334	Topics in the History of American Science and Technology	1/3
HI 3335	Topics in the History of Non-Western Science and Technology	1/3
HI 3341	Topics in Imperial and Postcolonial History	1/3
HI 3343	Topics in Asian History	1/3
HI 3344	Pacific Worlds	1/3

MQP in History (Minimum 3/3 Units)

Humanities and Arts Major with Concentration in Humanities Studies of Science and Technology

Degree Type
Concentration

This interdisciplinary concentration enables students to apply the methods of the humanities and social sciences to the study of science and technology.

Program Distribution Requirements for Humanities and Arts with Humanities Studies of Science and Technology Concentration

Designated HSST Courses (Minimum 2/3 Units)

Students must complete 2/3 units from List 1 ("Designated HSST Courses")

List 1: Designated HSST Courses

Item #	Title	Units
EN 2252	Science and Scientists in Modern Literature	1/3
HI 1330	Introduction to the History of Science and Technology	1/3
HI 1350	Introduction to Environmental History	1/3
HI 2335	Topics in the History of American Science and Technology	1/3
HI 2350	Topics in the History of Science	1/3
HI 2400	Topics in Environmental History	1/3
HI 2913	Capitalism and Its Discontents	1/3
HI 3317	Topics in Environmental History	1/3
HI 3331	Topics in the History of European Science and Technology	1/3
HI 3334	Topics in the History of American Science and Technology	1/3
HI 3335	Topics in the History of Non-Western Science and Technology	1/3
PY 2711	Epistemology	1/3
PY 2713	Bioethics	1/3
PY 2717	Philosophy and the Environment	1/3
PY 2719	Philosophy of Science	1/3

Closely Related Courses in Humanities (Minimum 2/3 Units)

Students must complete 2/3 units from List 1 ("Designated HSST Courses") or List 2 ("Closely Related Courses in Humanities")

Item #	Title	Units
AR 2114	Modern Architecture in the American Era, 1750-2001 and Beyond	1/3
AR 2115	Topics in Architecture Since 1960	1/3
AR 3112	Modernism, Mass Culture, and the Avant-Garde	1/3
HI 1311	Introduction to American Urban History	1/3
HI 2310	Topics in Urban History	1/3
HI 2315	The Shaping of Post-1920 America	1/3
HU 2251	Introduction to Film Studies	1/3
INTL 2210	Popular Culture and Social Change in Asia	1/3
INTL 1100	Introduction to International and Global Studies	1/3
INTL 2100	Approaches to Global Studies	1/3
INTL 2910	Topics in Global Studies	1/3
MU 2300	Foundations of Music Technology	1/3
MU 2501/PSY 2501	Music and Mind	1/3
RE 2722	Modern Problems of Belief	1/3
WR 1011	Writing About Science & Technology	1/3
WR 3214	Writing About Disease & Public Health	1/3

List 1: Designated HSST Courses

Item #	Title	Units
EN 2252	Science and Scientists in Modern Literature	1/3
HI 1330	Introduction to the History of Science and Technology	1/3
HI 1350	Introduction to Environmental History	1/3
HI 2335	Topics in the History of American Science and Technology	1/3
HI 2350	Topics in the History of Science	1/3
HI 2400	Topics in Environmental History	1/3
HI 2913	Capitalism and Its Discontents	1/3
HI 3317	Topics in Environmental History	1/3
HI 3331	Topics in the History of European Science and Technology	1/3
HI 3334	Topics in the History of American Science and Technology	1/3
HI 3335	Topics in the History of Non-Western Science and Technology	1/3
PY 2711	Epistemology	1/3
PY 2713	Bioethics	1/3
PY 2717	Philosophy and the Environment	1/3
PY 2719	Philosophy of Science	1/3

List 2: Closely Related Courses in Humanities

Item #	Title	Units
AR 2114	Modern Architecture in the American Era, 1750-2001 and Beyond	1/3

Science-Technology-Studies Courses in Other Areas (Minimum 2/3 Units)

Students must complete 2/3 units from List 3 ("Science-Technology-Studies Courses in Other Areas"). These may not include courses taken to fulfill the Social Science Requirement.

List 3: Science-Technology-Studies Courses in Other Areas

Item #	Title	Units
AR 3150/ID 3150	Light, Vision and Understanding	1/3
CS 3041	Human-Computer Interaction	1/3
CS 3043	Social Implications of Information Processing	1/3
DEV 1200	International Development and Society	1/3
DEV 2200	Case Studies in International Development Policy and Engineering	1/3
ENV 1100	Introduction to Environmental Studies	1/3
ENV 2201	Planning for Sustainable Communities	1/3
ENV 2310	Environmental Governance and Innovation	1/3
FY 1100 & FY 1101	The Great Problems Seminars	1/3
GOV 2302	Science-Technology Policy	1/3
GOV 2311	Environmental Policy and Law	1/3
GOV 2314/ID 2314	Cyberlaw and Policy	1/3
GOV 2315	Privacy: Laws, Policy, Technology, and How They Fit Together	1/3
GOV 2319/ENV 2319	Global Environmental Politics	1/3
GOV 3312	International Environmental Policy	1/3
IMGD 1000	Critical Studies of Interactive Media and Games	1/3
STS 1200	Fundamentals of Global Health	1/3
STS 4000	Senior Seminar in Global Public Health	1/3

MQP in Humanities Studies of Science and Technology (Minimum 3/3 Units)

Humanities and Arts Major with Concentration in Literature

Degree Type

Concentration

Program Distribution Requirements for Humanities and Arts with Literature Concentration

Literature Courses (Minimum 6/3 Units)

Students will complete 6/3 units of English (EN), Theatre (TH), or Writing and Rhetoric (WR) courses at the 2000 level or higher

2000+ Level English Courses

Item #	Title	Units
EN 2219	Creative Writing	1/3
EN 2225	The Literature of Sin	1/3
EN 2226	Infected Shakespeare: Venereal Disease, Madness, Plague	1/3
EN 2234	Modern American Novel	1/3
EN 2237	Literature and the Environment	1/3
EN 2242	Popular Fiction: Reading in Installments	1/3
EN 2243	Modern British Literature	1/3
EN 2244	19th-Century English Literature	1/3
EN 2251	Moral Issues in the Modern Novel	1/3
EN 2252	Science and Scientists in Modern Literature	1/3
EN 2271	American Literary Histories	1/3
EN 2281	World Literatures	1/3
EN 2500/TH 2500	Fundamentals of Technical Theatre	1/3
EN 3219	Advanced Creative Writing	1/3
EN 3226	Strange and Strangers	1/3
EN 3231	Supernatural Literatures	1/3
EN 3234	Modern American Poetry	1/3
EN 3238	American Authors	1/3
EN 3248	The English Novel	1/3
EN 3257	Topics in African American Literature	1/3
EN 3271	American Literary Topics	1/3

2000+ Level Theater Courses

Item #	Title	Units
EN 2500/TH 2500	Fundamentals of Technical Theatre	1/3
TH 2100	Fundamentals of Acting	1/3
TH 2400	Fundamentals of Theatrical Design	1/3
TH 2800	Departmental Theatre Production	1/3
TH 3200	Special Topics in Dramatic Literature	1/3
TH 3240	Playwriting	1/3
TH 3300	Special Topics in Performance Studies	1/3
TH 3510	Scenic Fabrication	1/3
TH 3800	Minor Capstone	1/3

2000+ Level Writing and Rhetoric Courses

Item #	Title	Units
IMGD 2450/WR 2450	Narrative Design for Interactive Media and Games	1/3
IMGD 3450/WR 3450	Writing Characters for Interactive Media & Games	1/3
WR 2010	Elements of Style	1/3
WR 2210	Business Writing and Communication	1/3
WR 2310	Visual Rhetoric	1/3
WR 2500	Writing in the Life Sciences	1/3
WR 3112	Rhetorical Theory	1/3
WR 3210	Technical Writing	1/3
WR 3214	Writing About Disease & Public Health	1/3
WR 3300	Cross-Cultural Communication	1/3
WR 4111	Research Methods in Writing	1/3
WR 4210	Medical Writing	1/3

MQP in Literature (Minimum 3/3 Units)

Humanities and Arts Major with Concentration in Music

Degree Type

Concentration

Program Distribution Requirements for Humanities and Arts with Music Concentration

Music Requirement (Minimum 6/3 Units)

Students will complete 6/3 units of Music (MU) at the 2000 level or higher

2000+ Level Music Courses

Item #	Title	Units
MU 2300	Foundations of Music Technology	1/3
MU 2501/PSY 2501	Music and Mind	1/3
MU 2611	Fundamentals of Music II	1/3
MU 2631	Glee Club	1/3
MU 2632	Alden Voices	1/3
MU 2633	Brass Ensemble	1/3
MU 2636	Concert Band	1/3
MU 2637	Orchestra	1/3
MU 2638	Chamber Choir	1/3
MU 2639	String Quartet	1/3
MU 2640	African Drumming Ensemble	1/3
MU 2641	Percussion Ensemble	1/3
MU 2642	Jazz Combo	1/3
MU 2643	Jazz Ensemble	1/3
MU 2644	Stage Band	1/3
MU 2719	Jazz History	1/3
MU 2720	Music History I: Medieval Through the Baroque	1/3
MU 2721	Music History II: Classical to the Present	1/3
MU 2722	History of American Popular Music	1/3
MU 2723	Music Composition	1/3
MU 2801	Making Music with Machines	1/3
MU 3001	World Music	1/3
MU 3002	Arranging and Orchestration	1/3
MU 3510	Music in Time of Conflict	1/3
MU 3614	Topics in Midi	1/3
MU 3615	Topics in Digital Sound	1/3
MU 3616	Topics in Interactive Programming	1/3
MU 3620	Electronic Music Composition	1/3
MU 3730	Jazz Theory	1/3
MU 4621	Independent Instruction (Lessons) in Music	1/3

MQP in Music (Minimum 3/3 Units)

Humanities and Arts Major with Concentration in Philosophy

Degree Type

Concentration

Program Distribution Requirements for Humanities and Arts Major with Concentration in Philosophy

Philosophy Requirement (Minimum 6/3 Units)

Students will complete 6/3 units of Philosophy (PY) 2000 level or higher

2000+ Level Philosophy Courses

Item #	Title	Units
PY 2711	Epistemology	1/3
PY 2712	Social and Political Philosophy	1/3
PY 2713	Bioethics	1/3
PY 2716/RE 2716	Gender, Race, and Class	1/3
PY 2717	Philosophy and the Environment	1/3
PY 2718	Existentialism and Phenomenology	1/3
PY 2719	Philosophy of Science	1/3
PY 2731/RE 2731	Ethics	1/3
PY 2734	Philosophy and Spirituality	1/3
PY 3712	Philosophy of Religion	1/3
PY 3721/RE 3721	Topics in Religion	1/3
RE 3711/PY 3711	Topics in Philosophy	1/3

MQP in Philosophy (Minimum 3/3 Units)

Humanities and Arts Major with Concentration in Religion

Degree Type

Concentration

Program Distribution Requirements for Humanities and Arts with Religion Concentration

Religion Requirement (Minimum 6/3 Units)

Students will complete 6/3 units of Religion (RE) 2000 level or higher

2000+ Level Religion Courses

Item #	Title	Units
PY 2716/RE 2716	Gender, Race, and Class	1/3
PY 2731/RE 2731	Ethics	1/3
PY 3721/RE 3721	Topics in Religion	1/3
RE 2721	Religion and Culture	1/3
RE 2722	Modern Problems of Belief	1/3
RE 2725	Religious and Spiritual Traditions	1/3
RE 3711/PY 3711	Topics in Philosophy	1/3
RE 3723	Religion, Gender & Sexuality	1/3

MQP in Religion (Minimum 3/3 Units)

Humanities and Arts Major with Concentration in Theatre

Degree Type

Concentration

2 units of TH or theatre-related courses (listed below) and MQP in Theatre. At least 3/3 units must be non-production courses; at least 2/3 units must be credited production work (may include Practicum and/or Minor Capstone); and all 6/3 units must be 2000 or above.

Program Distribution Requirements for Humanities and Arts Theatre Concentration

Theatre-Related Courses (Minimum 6/3 Units)

Student will complete 6/3 units of theatre (TH) or theatre-related courses at the 2000 level or higher

2000+ Level Theatre Courses

Item #	Title	Units
EN 2500/TH 2500	Fundamentals of Technical Theatre	1/3
TH 2100	Fundamentals of Acting	1/3
TH 2400	Fundamentals of Theatrical Design	1/3
TH 2800	Departmental Theatre Production	1/3
TH 3200	Special Topics in Dramatic Literature	1/3
TH 3240	Playwriting	1/3
TH 3300	Special Topics in Performance Studies	1/3
TH 3510	Scenic Fabrication	1/3
TH 3800	Minor Capstone	1/3

Theatre-Related Courses

Item #	Title	Units
EN 1222	Shakespeare in the Age of Elizabeth	1/3
EN 2226	Infected Shakespeare: Venereal Disease, Madness, Plague	1/3

MQP in Theatre (Minimum 3/3 Units)

Humanities and Arts Major with Concentration in Writing and Rhetoric

Degree Type

Concentration

Program Distribution Requirements for Humanities and Arts with Writing and Rhetoric Concentration

Writing and Rhetoric Requirement (Minimum 6/3 Units)

Students will complete 6/3 units of Writing and Rhetoric (WR) at the 2000 level or higher.

2000+ Level Writing and Rhetoric Courses

Item #	Title	Units
IMGD 2450/WR 2450	Narrative Design for Interactive Media and Games	1/3
IMGD 3450/WR 3450	Writing Characters for Interactive Media & Games	1/3
WR 2010	Elements of Style	1/3
WR 2210	Business Writing and Communication	1/3
WR 2310	Visual Rhetoric	1/3
WR 2500	Writing in the Life Sciences	1/3
WR 3112	Rhetorical Theory	1/3
WR 3210	Technical Writing	1/3
WR 3214	Writing About Disease & Public Health	1/3
WR 3300	Cross-Cultural Communication	1/3
WR 4111	Research Methods in Writing	1/3
WR 4210	Medical Writing	1/3

MQP in Writing and Rhetoric (Minimum 3/3 Units)

Humanities and Arts with American Studies Concentration

Degree Type

Concentration

This interdisciplinary concentration examines American culture from the multiple perspectives of American history, literature, and politics. American Studies at WPI takes advantage of the unparalleled resources at the American Antiquarian Society. American Studies majors (and minors) may earn two-thirds-unit of credit at the 3000-level by being admitted to and completing the competitive AAS fall seminar, which annually accepts twelve Worcester Consortium students. Each spring, HUA faculty publicize the upcoming seminar and endorse WPI applicants. AAS seminars typically enroll two or three students from WPI

Program Distribution Requirements for Humanities and Arts with American Studies Concentration

Introductory American Studies course (Minimum 1/3 Units)

1/3 units: one of the following courses: HU 1411 Introduction to American Studies, EN 1251 Introduction to American Literature, EN 1257 Introduction to African American Literature and Culture, HI 1311 Introduction to American Urban History, HI 1312 Introduction to American Social History, or HI 1314 Introduction to Early American History.

Introductory American Studies Courses

Item #	Title	Units
EN 1257	Introduction to African American Literature and Culture	1/3
HI 1311	Introduction to American Urban History	1/3
HI 1314	Introduction to Early American History	1/3
HU 1411	Introduction to American Studies	1/3

American History Courses (Minimum 2/3 Units)

List 1: American History

Item #	Title	Units
HI 2310	Topics in Urban History	1/3
HI 2311	American Colonial History	1/3
HI 2313	American History, 1789-1877	1/3
HI 2314	American History, 1877-1920	1/3
HI 2315	The Shaping of Post-1920 America	1/3
HI 2316	Twentieth Century American Foreign Relations	1/3
HI 2318	Topics in Law, Justice and American Society	1/3
HI 2335	Topics in the History of American Science and Technology	1/3
HI 2400	Topics in Environmental History	1/3
HI 2913	Capitalism and Its Discontents	1/3
HI 2930	Topics in Latin American History	1/3
HI 3312	Topics in American Social History	1/3
HI 3314	The American Revolution	1/3
HI 3316	Topics in Twentieth-Century U.S. History	1/3
HI 3317	Topics in Environmental History	1/3
HI 3334	Topics in the History of American Science and Technology	1/3
HI 3344	Pacific Worlds	1/3

American Literature Courses (Minimum 2/3 Units)

List 2: American Literature

Item #	Title	Units
EN 2234	Modern American Novel	1/3
EN 2237	Literature and the Environment	1/3
EN 2271	American Literary Histories	1/3
EN 3231	Supernatural Literatures	1/3
EN 3238	American Authors	1/3
EN 3271	American Literary Topics	1/3
ID 3531/SP 3531	Contemporary Us Latino Literature & Culture	1/3

American Politics, Law, and Policy Courses (Minimum 1/3 Units)

This may not include courses taken to fulfill the Social Science Requirement.

List 3: American Politics, Law, and Policy

Item #	Title	Units
GOV 1301	U.S. Government	1/3
GOV 1303	American Public Policy	1/3
GOV 1310	Law, Courts, and Politics	1/3
GOV 2302	Science-Technology Policy	1/3
GOV 2310	Constitutional Law: Foundations of Government	1/3

MQP in American Studies (Minimum 3/3 Units)

American Antiquarian Society Fall Seminar

This competitive seminar, open to a limited number of Worcester Consortium students, features a different visiting professor and a new thematic focus each fall. The seminar is equivalent to two courses in American Studies at the 3000-level; the comparable WPI discipline(s) will be determined by the topic of each seminar. To apply, consult a member of the American Studies faculty early in the preceding D-term.

American Art/Architecture Courses

Click Here to View More.

Item #	Title	Units
AR 2114	Modern Architecture in the American Era, 1750-2001 and Beyond	1/3

American Music Courses

Click Here to View More

Item #	Title	Units
MU 2719	Jazz History	1/3
MU 2722	History of American Popular Music	1/3

American Philosophy and Religion Courses

For RE 2721 and PY/RE 3721, check with an American Studies advisor to determine if this course has an American focus in a given term. To facilitate degree audits by the Office of the Registrar, HUA faculty will create a form by which to approve unlisted courses that have significant focus on the U.S. national experience.

Click Here to View More.

Item #	Title	Units
PY 2716/RE 2716	Gender, Race, and Class	1/3
RE 2721	Religion and Culture	1/3
PY 3721/RE 3721	Topics in Religion	1/3
PY 2716/RE 2716	Gender, Race, and Class	1/3
PY 3721/RE 3721	Topics in Religion	1/3
RE 2721	Religion and Culture	1/3

Interactive Media and Game Development

DIRECTOR: G. Smith

ASSOCIATED FACULTY: E. Agu (CS), S. Barton (HUA), S. Bhada (ECE), F. Bianchi (HUA), R. Bigonah (HUA), R. Bohrer (CS), F. Chery (IMGD), M. Claypool (CS), J. deWinter (HUA), R. Dempski (CBC), R. DuPlessis (IMGD), A. Gonzalez (HUA), E. Gutierrez (HUA), M. Kagen (IMGD), L. Harrison (CS), N. Heffernan (CS), M. Keller (HUA), V.J. Manzo (HUA), E. Ottmar (SSPS), C. Roberts (CS), J. Rosenstock (HUA), J. Sanbonmatsu (HUA), B. Schneider (IMGD), E. Solovey (CS), R. Sutter (IMGD), Y. Telliel (HUA), W. Yarbrough (IMGD)

Program Educational Objectives

The educational objectives of the IMGD program are:

- To prepare students for technical and/or creative roles in the interactive media and game industries.

- To provide a solid base of IMGD-related technical and/or creative expertise, strong written and oral communication skills, and substantial experience in collaborating effectively in multidisciplinary teams.
- To cultivate an understanding of the social and ethical issues relevant to interactive media and games, together with a sense of personal responsibility and professionalism.
- To develop personal traits necessary for continuous career growth, including
- The ability to integrate theory and practice.
- The ability to think analytically and critically in order to define, analyze and solve technical and/or creative challenges.
- The ability to learn new skills in response to evolving technology and a dynamic professional environment.

Program Outcomes

The specific outcomes for the IMGD program are that all graduates will:

1. Demonstrate practical skill and in-depth understanding of IMGD-related technologies, concepts, tools and aesthetics.
2. Have a base of knowledge in computer science, mathematics and the natural/engineering sciences.
3. Have a base of knowledge in IMGD-related design, audio, cultural narratives and visual arts.
4. Be aware of social and philosophical issues pertaining to interactive media and games.
5. Be able to creatively express and analyze artistic forms relative to IMGD.
6. Communicate effectively orally, in writing, and in visual media.
7. Successfully complete individual projects.
8. Successfully complete a group project with students from other IMGD disciplines.
9. Successfully complete team-based, full-term IMGD projects.
10. Successfully complete a team-based, multi-term IMGD project.

Interactive Media & Game Development Major

Degree Type
Bachelor of Arts

NOTE: IMGD majors may not earn a double major in IMGD Technology.

Program Distribution Requirements for the Interactive Media and Game Design Major

IMGD Core (Minimum 2/3 Units)

Item #	Title	Units
IMGD 1000	Critical Studies of Interactive Media and Games	1/3
IMGD 1001	The Game Development Process	1/3
IMGD 1002	Storytelling in Interactive Media and Games	1/3

IMGD Design (Minimum 1/3 Units)

Item #	Title	Units
IMGD 2500	Design of Tabletop Strategy Games	1/3
IMGD 2900	Digital Game Design I	1/3
IMGD 3900	Digital Game Design II	1/3
IMGD 4200	History and Future of Immersive and Interactive Media	1/3
IMGD 4600	Serious Games	1/3
IMGD 4700	Advanced Storytelling: Quest Logic and Level Design	1/3
IMGD 4900	Digital Game Design Studio	1/3
IMGD 5000	Game Design Studio	1/3
IMGD 5200	History and Future of Immersive and Interactive Media	1/3
IMGD 5300	Design of Interactive Experiences	1/3
MIS 4741	User Experience and Design	1/3

Students may apply either IMGD 4200 or IMGD 5200, but not both.

IMGD Audio (Minimum 1/3 Units)

Item #	Title	Units
IMGD 2030	Game Audio I	1/3
IMGD 3030	Game Audio II	1/3

IMGD Social & Philosophical Issues (Minimum 1/3 Units)

Item #	Title	Units
IMGD 2000	Social Issues in Interactive Media and Games	1/3

Cultural Narratives (Minimum 1/3 Units)

Choose 1/3 unit from any course with an EN, PY or RE prefix:

English (EN) Courses

Item #	Title	Units
EN 1219	Introduction to Creative Writing	1/3
EN 1221/TH 1221	Introduction to Theatre on Page and Stage	1/3
EN 1222	Shakespeare in the Age of Elizabeth	1/3
EN 1242	Introduction to English Poetry	1/3
EN 1251	Introduction to Literature	1/3
EN 1257	Introduction to African American Literature and Culture	1/3
EN 1259	Introduction to Contemporary Chicana/o Literature	1/3
EN 2219	Creative Writing	1/3
EN 2225	The Literature of Sin	1/3
EN 2226	Infected Shakespeare: Venereal Disease, Madness, Plague	1/3
EN 2234	Modern American Novel	1/3
EN 2237	Literature and the Environment	1/3
EN 2242	Popular Fiction: Reading in Installments	1/3
EN 2243	Modern British Literature	1/3
EN 2244	19th-Century English Literature	1/3
EN 2251	Moral Issues in the Modern Novel	1/3
EN 2252	Science and Scientists in Modern Literature	1/3
EN 2271	American Literary Histories	1/3
EN 2281	World Literatures	1/3
EN 2500/TH 2500	Fundamentals of Technical Theatre	1/3
EN 3219	Advanced Creative Writing	1/3
EN 3226	Strange and Strangers	1/3
EN 3231	Supernatural Literatures	1/3
EN 3234	Modern American Poetry	1/3
EN 3238	American Authors	1/3
EN 3248	The English Novel	1/3
EN 3257	Topics in African American Literature	1/3
EN 3271	American Literary Topics	1/3

Philosophy (PY) Courses

Item #	Title	Units
PY 1731/RE 1731	Introduction to Philosophy and Religion	1/3
PY 2711	Epistemology	1/3
PY 2712	Social and Political Philosophy	1/3
PY 2713	Bioethics	1/3
PY 2716/RE 2716	Gender, Race, and Class	1/3
PY 2717	Philosophy and the Environment	1/3
PY 2718	Existentialism and Phenomenology	1/3
PY 2719	Philosophy of Science	1/3
PY 2731/RE 2731	Ethics	1/3
PY 2734	Philosophy and Spirituality	1/3
PY 3712	Philosophy of Religion	1/3
PY 3721/RE 3721	Topics in Religion	1/3
RE 3711/PY 3711	Topics in Philosophy	1/3

Religion (RE) Courses

Item #	Title	Units
PY 1731/RE 1731	Introduction to Philosophy and Religion	1/3
PY 2716/RE 2716	Gender, Race, and Class	1/3
PY 2731/RE 2731	Ethics	1/3
PY 3721/RE 3721	Topics in Religion	1/3
RE 2721	Religion and Culture	1/3
RE 2722	Modern Problems of Belief	1/3
RE 2725	Religious and Spiritual Traditions	1/3
RE 3711/PY 3711	Topics in Philosophy	1/3
RE 3723	Religion, Gender & Sexuality	1/3

Visual Arts (Minimum 1/3 Units)

Item #	Title	Units
AR 1100	Essentials of Art	1/3
AR 1101	Digital Imaging and Computer Art	1/3
AR 2301	Graphic Design	1/3

Natural & Engineering Sciences (Minimum 2/3 Units)

Choose 2/3 units from any course with an AE, AREN, BB, BCB, BME, CE, CH, CHE, ECE, ES, GE, ME, NEU, PH or RBE prefix.

Aerospace Engineering (AE) Courses

Item #	Title	Units
AE 2110	Introduction to Incompressible Fluid Dynamics	1/3
AE 2310	Introduction to Aerospace Control Systems	1/3
AE 2320	Introduction to Orbital Mechanics	1/3
AE 2410	Introduction to Aerospace Structures	1/3
AE 3110	Fundamentals of Compressible Fluid Dynamics	1/3
AE 3120	Fundamentals of Aerodynamics	1/3
AE 3310	Fundamentals of Navigation and Communication	1/3
AE 3420	Fundamentals of Aerospace Structures	1/3
AE 3430	Fundamentals of Composite Materials	1/3
AE 4210	Fundamentals of Air-Breathing Propulsion	1/3
AE 4220	Fundamentals of Rocket Propulsion	1/3
AE 4310	Fundamentals of Aircraft Dynamics and Control	1/3
AE 4320	Fundamentals of Spacecraft Dynamics and Control	1/3
AE 4410	Fundamentals of Structural Dynamics	1/3
AE 4510	Aircraft Design	1/3
AE 4520	Spacecraft and Mission Design	1/3
PH 2550/AE 2550	Atmospheric and Space Environments	1/3

Architectural Engineering (AREN) Courses

Item #	Title	Units
AREN 2002	Architectural Design I	1/3
AREN 2004	Architectural Design II - Light and Lighting Systems	1/3
AREN 2023	Introduction to Architectural Engineering Systems	1/3
AREN 2025	Building Electrical Systems	1/3
AREN 3002	Architectural Design III	1/3
AREN 3003	Principles of HVAC Design for Buildings	1/3
AREN 3005	Lighting Systems	1/3
AREN 3006	Advanced HVAC System Design	1/3
AREN 3020	Architectural Design IV - Building Energy Simulation	1/3
AREN 3022	Architectural Design V - Building Envelope Design	1/3
AREN 3024	Building Physics	1/3
AREN 3025	Building Energy Simulation	1/3

Biology and Biotechnology (BB) Courses

Item #	Title	Units
BB 1001	Introduction to Biology	1/3
BB 1002	Environmental Biology	1/3
BB 1003/BCB 1003	Exploring Bioinformatics and Computational Biology	1/3
BB 1025	Human Biology	1/3
BB 1035	Biotechnology	1/3
BB 1045	Biodiversity	1/3
BB 2002	Microbiology	1/3
BB 2003	Fundamentals of Microbiology	1/3
BB 2030	Plant Diversity	1/3
BB 2040	Principles of Ecology	1/3
BB 2050	Animal Behavior	1/3
BB 2550	Cell Biology	1/3
BB 2902	Enzymes, Proteins, and Purification	1/6
BB 2903	Anatomy and Physiology	1/6
BB 2904	Ecology, Environment, and Animal Behavior	1/6
BB 2915	Searching for Solutions in Soil: Microbial and Molecular Investigations	1/3
BB 2917	Hunting for Phage	1/3
BB 2920	Genetics	1/3
BB 2950	Molecular Biology	1/3
BB 3003	Medical Microbiology: Plagues of the Modern World, a Case Study Approach	1/3
BB 3010/BCB 3010	Simulation in Biology	1/3
BB 3050	Cancer Biology	1/3
BB 3080	Neurobiology	1/3
BB 3101	Human Anatomy & Physiology: Movement and Communication	1/3
BB 3102	Human Anatomy & Physiology: Transport and Maintenance	1/3
BB 3120	Plant Physiology	1/3
BB 3140	Evolution: Pattern and Process	1/3
BB 3512	Molecular Genetics Lab	1/6
BB 3513	Cell Culture Techniques for Animal Cells	1/6
BB 3515	Physiologic Systems Laboratory	1/3
BB 3517	Fermentation	1/6
BB 3519	Protein Purification	1/6
BB 3521	Microscopy	1/6
BB 3525	Plant Physiology	1/6
BB 3526	Phage Hunters: the Analysis	1/6
BB 3527	Molecular Biology and Genetic Engineering: Approaches and Applications	1/3
BB 3530	Immunotherapies: The Next Generation of Pharmaceuticals	1/3
BB 3570	Cell Culture Models for Tissue Regeneration	1/3
BB 3620	Developmental Biology	1/3
BB 3920	Immunology	1/3
BB 4150	Environmental Change: Problems and Approaches	1/3
BB 4170/CH 4170	Experimental Genetic Engineering	1/3
BB 4190/CH 4190	Regulation of Gene Expression	1/3
BB 4260	Synthetic Biology	1/3
BB 4801/BCB 4001	Bioinformatics	1/3
BB 4900	Capstone Experience in Biology and Biotechnology	1/3

Bioinformatics and Computational Biology (BCB) Courses

Item #	Title	Units
BB 1003/BCB 1003	Exploring Bioinformatics and Computational Biology	1/3
BB 3010/BCB 3010	Simulation in Biology	1/3
BB 4801/BCB 4001	Bioinformatics	1/3
BCB 4002/CS 4802	Biovisualization	1/3
BCB 4003/CS 4803	Biological and Biomedical Database Mining	1/3
BCB 4004/MA 4603	Statistical Methods in Genetics and Bioinformatics	1/3

Biomedical Engineering (BME) Courses

Item #	Title	Units
BME 1001	Introduction to Biomedical Engineering	1/3
BME 1004	Introduction to Programming in Matlab	1/3
BME 2001	Introduction to Biomaterials	1/3
BME 2210	Biomedical Signals, Instruments and Measurements	1/3
BME 2211	Biomedical Data Analysis	1/3
BME 2502	Introduction to Biomechanics: Stress Analysis	1/3
BME 2610	Introduction to Bioprocess Engineering	1/3
BME 3012	Biomedical Sensors Laboratory	1/6
BME 3013	Biomedical Instrumentation Laboratory	1/6
BME 3014	Physiological Signals Laboratory I: Techniques	1/6
BME 3111	Physiology and Engineering	1/3
BME 3112	Human Physiology for Biomedical Engineers	1/3
BME 3300	Biomedical Engineering Design	1/3
BME 3503	Skeletal Biomechanics Laboratory	1/6
BME 3505	Solid Biomechanics Laboratory: Techniques	1/6
BME 3506	Solid Biomechanics Laboratory: Applications	1/6
BME 3605	Biotransport Laboratory II: Applications	1/6
BME 3610	Transport Analysis in Bioengineering	1/3
BME 3811	Biomaterials Lab	1/6
BME 3813	Cellular Engineering Lab	1/6
BME 4011/ECE 4011	Biomedical Signal Analysis	1/3
BME 4023/ECE 4023	Biomedical Instrumentation Design	1/3
BME 4201	Biomedical Imaging	1/3
BME 4300	MQP Capstone Design	1/6
BME 4503	Computational Biomechanics	1/3
BME 4504/ME 4504	Biomechanics	1/3
BME 4606/ME 4606	Biofluids	1/3
BME 4701	Cell and Molecular Bioengineering	1/3
BME 4814/ME 4814	Biomaterials	1/3
BME 4828	Biomaterials-Tissue Interactions	1/3
BME 4831	Drug Delivery	1/3

Civil and Environmental Engineering (CE) Courses

Item #	Title	Units
CE 1030	Civil Engineering and Computer Fundamentals	1/3
CE 2000	Analytical Mechanics I	1/3
CE 2001	Analytical Mechanics II	1/3
CE 2002	Introduction to Analysis and Design	1/3
CE 2020	Surveying	1/3
CE 3006	Design of Steel Structures	1/3
CE 3008	Design of Reinforced Concrete Structures	1/3
CE 3010	Structural Engineering	1/3
CE 3020	Project Management	1/3
CE 3022	Legal Aspects of Professional Practice	1/3
CE 3025	Project Evaluation	1/3
CE 3026	Materials of Construction	1/3
CE 3030	Fundamentals of Civil Engineering Autocad	1/3
CE 3031	Building Information Modeling: Software Tools and Principles	1/3
CE 3041	Soil Mechanics	1/3
CE 3044	Foundation Engineering	1/3
CE 3050	Traffic Engineering	1/3
CE 3051	Pavement Engineering	1/3
CE 3059	Environmental Engineering	1/3
CE 3060	Water Treatment	1/3
CE 3061	Sustainable Wastewater Engineering: Treatment and Reuse	1/3
CE 3062	Hydraulics	1/3
CE 3070	Urban and Environmental Planning	1/3
CE 3074	Environmental Analysis	1/3
CE 4007	Matrix Analysis of Structures	1/3
CE 4060	Environmental Engineering Laboratory	1/3
CE 4061	Hydrology	1/3
CE 4063/CHE 4063	Transport & Transformations in the Environment	1/3
CE 4071	Land Use Development and Controls	1/3
CE 4600	Hazardous and Industrial Waste Management	1/3
CE 4610	Solid Waste Engineering	1/3

Chemistry and Biochemistry (CH) Courses

Item #	Title	Units
BB 4170/CH 4170	Experimental Genetic Engineering	1/3
BB 4190/CH 4190	Regulation of Gene Expression	1/3
CH 1010	Chemical Properties, Bonding, and Forces	1/3
CH 1020	Chemical Reactions	1/3
CH 1030	Kinetics, Equilibrium and Thermodynamics	1/3
CH 1040	Spectroscopy in Organic and Polymer Chemistry	1/3
CH 2310	Organic Chemistry I	1/3
CH 2320	Organic Chemistry II	1/3
CH 2330	Organic Chemistry III	1/3
CH 2360	Organic Laboratory	1/3
CH 2640	Experimental Chemistry I: Instrumental Analysis	1/3
CH 2650	Modern Physical Chemistry Methods	1/3
CH 2660	Organic Synthesis and Analysis Laboratory	1/3
CH 2670	Investigation of Coordination Complexes Through Inquiry	1/3
CH 3310	Advanced Organic Chemistry	1/3
CH 3410	Structure, Bonding, and Reactivity in Inorganic Chemistry	1/3
CH 3510	Chemical Thermodynamics	1/3
CH 3530	Quantum Chemistry	1/3
CH 3550	Chemical Dynamics	1/3
CH 4110	Protein Structure and Function	1/3
CH 4120	Lipids and Biomembrane Functions	1/3
CH 4130	Nucleic Acids and Bioinformation	1/3
CH 4140	Metabolism and Disease	1/3
CH 4150	Enzymology and Protein Characterization Laboratory	1/3
CH 4160	Membrane Biophysics	1/3
CH 4330	Organic Synthesis	1/3
CH 4420	Principles and Applications of Group Theory in Chemistry	1/3
CH 4520	Chemical Statistical Mechanics	1/3

Chemical Engineering (CHE) Courses

Item #	Title	Units
CE 4063/CHE 4063	Transport & Transformations in the Environment	1/3
CHE 1011	Introduction to Chemical Engineering	1/3
CHE 2011	Chemical Engineering Fundamentals	1/3
CHE 2012	Elementary Chemical Processes	1/3
CHE 2013	Applied Chemical Engineering Thermodynamics	1/3
CHE 2014	Advanced Chemical Processes	1/3
CHE 3201	Kinetics and Reactor Design	1/3
CHE 3301	Introduction to Biological Engineering	1/3
CHE 3501	Applied Mathematics in Chemical Engineering	1/3
CHE 3702	Energy Challenges in the 21st Century	1/3
CHE 3722	Bioenergy	1/3
CHE 4401	Unit Operations of Chemical Engineering I	1/3
CHE 4402	Unit Operations of Chemical Engineering II	1/3
CHE 4403	Chemical Engineering Design	1/3
CHE 4404	Chemical Plant Design Project	1/3
CHE 4405	Chemical Process Dynamics and Control Laboratory	1/3
CHE 4410	Chemical Process Safety Design	1/3

Electrical and Computer Engineering (ECE) Courses

Item #	Title	Units
BME 4011/ECE 4011	Biomedical Signal Analysis	1/3
BME 4023/ECE 4023	Biomedical Instrumentation Design	1/3
CS 4801/ECE 4802	Introduction to Cryptography and Communication Security	1/3
ECE 1799	Frontiers and Current Issues of Electrical and Computer Engineering	1/6
ECE 2010	Introduction to Electrical and Computer Engineering	1/3
ECE 2019	Sensors, Circuits, and Systems	1/3
ECE 2029	Introduction to Digital Circuit Design	1/3
ECE 2049	Embedded Computing in Engineering Design	1/3
ECE 2112	Electromagnetic Fields	1/3
ECE 2201	Microelectronic Circuits I	1/3
ECE 2305	Introduction to Communications and Networks	1/3
ECE 2311	Continuous-Time Signal and System Analysis	1/3
ECE 2312	Discrete-Time Signal and System Analysis	1/3
ECE 2799	Electrical and Computer Engineering Design	1/3
ECE 3012	Introduction to Control Systems Engineering	1/3
ECE 3113	Introduction to RF Circuit Design	1/3
ECE 3204	Microelectronic Circuits II	1/3
ECE 3308	Introduction to Wireless Networks	1/3
ECE 3311	Principles of Communication Systems	1/3
ECE 3500	Electric Power and Renewable Energy Systems	1/3
ECE 3501	Electromechanical Energy Systems	1/3
ECE 3829	Advanced Digital System Design with FPGAs	1/3
ECE 3849	Real-Time Embedded Systems	1/3
ECE 4305	Software-Defined Radio Systems and Analysis	1/3
ECE 4503	Power Electronics And Power Management	1/3
ECE 4703	Real-Time Digital Signal Processing	1/3
ECE 4801	Computer Organization and Design	1/3
ECE 4902	Analog Integrated Circuit Design	1/3
ECE 4904	Semiconductor Devices	1/3

Engineering Science Interdisciplinary (ES) Courses

Item #	Title	Units
ES 1020	Introduction to Engineering	1/3
ES 1310	Introduction to Computer Aided Design	1/3
ES 1500	Fundamentals of Systems Thinking	1/3
ES 2001	Introduction to Materials Science	1/3
ES 2501	Introduction to Static Systems	1/3
ES 2502	Stress Analysis	1/3
ES 2503	Introduction to Dynamic Systems	1/3
ES 2800	Environmental Impacts of Engineering Decisions	1/3
ES 3001	Introduction to Thermodynamics	1/3
ES 3002	Mass Transfer	1/3
ES 3003	Heat Transfer	1/3
ES 3004	Fluid Mechanics	1/3
ES 3011	Control Engineering I	1/3
ES 3323	Advanced Computer Aided Design	1/3
ES 3501	A Project-Based Introduction to Systems Engineering	1/3

Geosciences (GE) Courses

Item #	Title	Units
GE 2341	Geology	1/3

Mechanical Engineering (ME) Courses

Item #	Title	Units
BME 4504/ME 4504	Biomechanics	1/3
BME 4606/ME 4606	Biofluids	1/3
BME 4814/ME 4814	Biomaterials	1/3
ME 1520	The Technology of Alpine SkIIng	1/3
ME 1800	Manufacturing Science, Prototyping, and Computer-Controlled Machining	1/3
ME 2300	Introduction to Engineering Design	1/3
ME 2312	Introduction to Computational Solutions for Engineering Problems	1/3
ME 2820	Materials Processing	1/3
ME 3310	Kinematics of Mechanisms	1/3
ME 3311	Dynamics of Mechanisms and Machines	1/3
ME 3320	Design of Machine Elements	1/3
ME 3411	Intermediate Fluid Mechanics	1/3
ME 3501	Elementary Continuum Mechanics	1/3
ME 3506	Rehabilitation Engineering	1/3
ME 3820	Computer-Aided Manufacturing	1/3
ME 3901	Engineering Experimentation	1/3
ME 3902	Project-Based Engineering Experimentation	1/3
ME 4320	Advanced Engineering Design	1/3
ME 4323	Fundamentals of Drivetrain Systems	1/3
ME 4324	Integrated Design of Mechanical Systems	1/3
ME 4422	Design and Optimization of Thermal Systems	1/3
ME 4424	Radiation Heat Transfer Application and Design	1/3
ME 4429	Thermofluid Application and Design	1/3
ME 4430	Integrated Thermomechanical Design and Analysis	1/3
ME 4505	Advanced Dynamics	1/3
ME 4506	Mechanical Vibrations	1/3
ME 4512	Introduction to the Finite Element Method	1/3
ME 4710	Gas Turbines for Propulsion and Power Generation	1/3
ME 4813	Ceramics and Glasses for Engineering Applications	1/3
ME 4821	Plastics	1/3
ME 4832	Corrosion and Corrosion Control	1/3
ME 4840	Physical Metallurgy	1/3
ME 4875/MTE 575	Introduction to Nanomaterials and Nanotechnology	1/3
RBE 4322/ME 4322	Modeling and Analysis of Mechatronic Systems	1/3

Neuroscience (NEU) Courses

Physics (PH) Courses

Item #	Title	Units
PH 1110	General Physics—Mechanics	1/3
PH 1111	Principles of Physics—Mechanics	1/3
PH 1120	General Physics—Electricity and Magnetism	1/3
PH 1121	Principles of Physics—Electricity and Magnetism	1/3
PH 1130	Modern Physics	1/3
PH 1140	Oscillations and Waves	1/3
PH 1150	Introductory Physics of Living Systems	1/3
PH 2101	Principles of Thermodynamics	1/3
PH 2201	Intermediate Mechanics I	1/3
PH 2202	Intermediate Mechanics II	1/3
PH 2301	Electromagnetic Fields	1/3
PH 2501	Photonics	1/3
PH 2502	Lasers	1/3
PH 2510	Atomic Force Microscopy	1/3
PH 2520	Introduction to Astrophysics	1/3
PH 2540	Solar Systems	1/3
PH 2550/AE 2550	Atmospheric and Space Environments	1/3
PH 2601	Photonics Laboratory	1/3
PH 2651	Intermediate Physics Laboratory	1/3
PH 3206	Statistical Physics	1/3
PH 3301	Electromagnetic Theory	1/3
PH 3401	Quantum Mechanics I	1/3
PH 3402	Quantum Mechanics II	1/3
PH 3501	Relativity	1/3
PH 3502	Solid State Physics	1/3
PH 3503	Nuclear Physics	1/3
PH 3504	Optics	1/3
PH 4201/PH 511	Advanced Classical Mechanics	1/3

Robotics Engineering (RBE) Courses

Item #	Title	Units
RBE 1001	Introduction to Robotics	1/3
RBE 2001	Unified Robotics I: Actuation	1/3
RBE 2002	Unified Robotics II: Sensing	1/3
RBE 3001	Unified Robotics III: Manipulation	1/3
RBE 3002	Unified Robotics IV: Navigation	1/3
RBE 3100	Social Implications of Robotics	1/3
RBE 4322/ME 4322	Modeling and Analysis of Mechatronic Systems	1/3
RBE 4540	Vision-based Robotic Manipulation	1/3
RBE 4815	Industrial Robotics	1/3

General Sciences (Minimum 1/3 Units)

Choose 1/3 unit from any course with an AE, AREN, BB, BCB, BME, CE, CH, CHE, CS (except CS 2022 or CS 3043), DS, ECE, ES, GE, MA, ME, PH or RBE prefix.

Aerospace Engineering (AE) Courses

Item #	Title	Units
AE 2110	Introduction to Incompressible Fluid Dynamics	1/3
AE 2310	Introduction to Aerospace Control Systems	1/3
AE 2320	Introduction to Orbital Mechanics	1/3
AE 2410	Introduction to Aerospace Structures	1/3
AE 3110	Fundamentals of Compressible Fluid Dynamics	1/3
AE 3120	Fundamentals of Aerodynamics	1/3
AE 3310	Fundamentals of Navigation and Communication	1/3
AE 3420	Fundamentals of Aerospace Structures	1/3
AE 3430	Fundamentals of Composite Materials	1/3
AE 4210	Fundamentals of Air-Breathing Propulsion	1/3
AE 4220	Fundamentals of Rocket Propulsion	1/3
AE 4310	Fundamentals of Aircraft Dynamics and Control	1/3
AE 4320	Fundamentals of Spacecraft Dynamics and Control	1/3
AE 4410	Fundamentals of Structural Dynamics	1/3
AE 4510	Aircraft Design	1/3
AE 4520	Spacecraft and Mission Design	1/3
PH 2550/AE 2550	Atmospheric and Space Environments	1/3

Architectural Engineering (AREN) Courses

Item #	Title	Units
AREN 2002	Architectural Design I	1/3
AREN 2004	Architectural Design II - Light and Lighting Systems	1/3
AREN 2023	Introduction to Architectural Engineering Systems	1/3
AREN 2025	Building Electrical Systems	1/3
AREN 3002	Architectural Design III	1/3
AREN 3003	Principles of HVAC Design for Buildings	1/3
AREN 3005	Lighting Systems	1/3
AREN 3006	Advanced HVAC System Design	1/3
AREN 3020	Architectural Design IV - Building Energy Simulation	1/3
AREN 3022	Architectural Design V - Building Envelope Design	1/3
AREN 3024	Building Physics	1/3
AREN 3025	Building Energy Simulation	1/3

Biology and Biotechnology (BB) Courses

Item #	Title	Units
BB 1001	Introduction to Biology	1/3
BB 1002	Environmental Biology	1/3
BB 1003/BCB 1003	Exploring Bioinformatics and Computational Biology	1/3
BB 1025	Human Biology	1/3
BB 1035	Biotechnology	1/3
BB 1045	Biodiversity	1/3
BB 2002	Microbiology	1/3
BB 2003	Fundamentals of Microbiology	1/3
BB 2030	Plant Diversity	1/3
BB 2040	Principles of Ecology	1/3
BB 2050	Animal Behavior	1/3
BB 2550	Cell Biology	1/3
BB 2902	Enzymes, Proteins, and Purification	1/6
BB 2903	Anatomy and Physiology	1/6
BB 2904	Ecology, Environment, and Animal Behavior	1/6
BB 2915	Searching for Solutions in Soil: Microbial and Molecular Investigations	1/3
BB 2917	Hunting for Phage	1/3
BB 2920	Genetics	1/3
BB 2950	Molecular Biology	1/3
BB 3003	Medical Microbiology: Plagues of the Modern World, a Case Study Approach	1/3
BB 3010/BCB 3010	Simulation in Biology	1/3
BB 3050	Cancer Biology	1/3
BB 3080	Neurobiology	1/3
BB 3101	Human Anatomy & Physiology: Movement and Communication	1/3
BB 3102	Human Anatomy & Physiology: Transport and Maintenance	1/3
BB 3120	Plant Physiology	1/3
BB 3140	Evolution: Pattern and Process	1/3
BB 3512	Molecular Genetics Lab	1/6
BB 3513	Cell Culture Techniques for Animal Cells	1/6
BB 3515	Physiologic Systems Laboratory	1/3
BB 3517	Fermentation	1/6
BB 3519	Protein Purification	1/6
BB 3521	Microscopy	1/6
BB 3525	Plant Physiology	1/6
BB 3526	Phage Hunters: the Analysis	1/6
BB 3527	Molecular Biology and Genetic Engineering: Approaches and Applications	1/3
BB 3530	Immunotherapies: The Next Generation of Pharmaceuticals	1/3
BB 3570	Cell Culture Models for Tissue Regeneration	1/3
BB 3620	Developmental Biology	1/3
BB 3920	Immunology	1/3
BB 4150	Environmental Change: Problems and Approaches	1/3
BB 4170/CH 4170	Experimental Genetic Engineering	1/3
BB 4190/CH 4190	Regulation of Gene Expression	1/3
BB 4260	Synthetic Biology	1/3
BB 4801/BCB 4001	Bioinformatics	1/3
BB 4900	Capstone Experience in Biology and Biotechnology	1/3

Bioinformatics and Computational Biology (BCB) Courses

Item #	Title	Units
BB 1003/BCB 1003	Exploring Bioinformatics and Computational Biology	1/3
BB 3010/BCB 3010	Simulation in Biology	1/3
BB 4801/BCB 4001	Bioinformatics	1/3
BCB 4002/CS 4802	Biovisualization	1/3
BCB 4003/CS 4803	Biological and Biomedical Database Mining	1/3
BCB 4004/MA 4603	Statistical Methods in Genetics and Bioinformatics	1/3

Biomedical Engineering (BME) Courses

Item #	Title	Units
BME 1001	Introduction to Biomedical Engineering	1/3
BME 1004	Introduction to Programming in Matlab	1/3
BME 2001	Introduction to Biomaterials	1/3
BME 2210	Biomedical Signals, Instruments and Measurements	1/3
BME 2211	Biomedical Data Analysis	1/3
BME 2502	Introduction to Biomechanics: Stress Analysis	1/3
BME 2610	Introduction to Bioprocess Engineering	1/3
BME 3012	Biomedical Sensors Laboratory	1/6
BME 3013	Biomedical Instrumentation Laboratory	1/6
BME 3014	Physiological Signals Laboratory I: Techniques	1/6
BME 3111	Physiology and Engineering	1/3
BME 3112	Human Physiology for Biomedical Engineers	1/3
BME 3300	Biomedical Engineering Design	1/3
BME 3503	Skeletal Biomechanics Laboratory	1/6
BME 3505	Solid Biomechanics Laboratory: Techniques	1/6
BME 3506	Solid Biomechanics Laboratory: Applications	1/6
BME 3605	Biotransport Laboratory II: Applications	1/6
BME 3610	Transport Analysis in Bioengineering	1/3
BME 3811	Biomaterials Lab	1/6
BME 3813	Cellular Engineering Lab	1/6
BME 4011/ECE 4011	Biomedical Signal Analysis	1/3
BME 4023/ECE 4023	Biomedical Instrumentation Design	1/3
BME 4201	Biomedical Imaging	1/3
BME 4300	MQP Capstone Design	1/6
BME 4503	Computational Biomechanics	1/3
BME 4504/ME 4504	Biomechanics	1/3
BME 4606/ME 4606	Biofluids	1/3
BME 4701	Cell and Molecular Bioengineering	1/3
BME 4814/ME 4814	Biomaterials	1/3
BME 4828	Biomaterials-Tissue Interactions	1/3
BME 4831	Drug Delivery	1/3

Civil and Environmental Engineering (CE) Courses

Item #	Title	Units
CE 1030	Civil Engineering and Computer Fundamentals	1/3
CE 2000	Analytical Mechanics I	1/3
CE 2001	Analytical Mechanics II	1/3
CE 2002	Introduction to Analysis and Design	1/3
CE 2020	Surveying	1/3
CE 3006	Design of Steel Structures	1/3
CE 3008	Design of Reinforced Concrete Structures	1/3
CE 3010	Structural Engineering	1/3
CE 3020	Project Management	1/3
CE 3022	Legal Aspects of Professional Practice	1/3
CE 3025	Project Evaluation	1/3
CE 3026	Materials of Construction	1/3
CE 3030	Fundamentals of Civil Engineering Autocad	1/3
CE 3031	Building Information Modeling: Software Tools and Principles	1/3
CE 3041	Soil Mechanics	1/3
CE 3044	Foundation Engineering	1/3
CE 3050	Traffic Engineering	1/3
CE 3051	Pavement Engineering	1/3
CE 3059	Environmental Engineering	1/3
CE 3060	Water Treatment	1/3
CE 3061	Sustainable Wastewater Engineering: Treatment and Reuse	1/3
CE 3062	Hydraulics	1/3
CE 3070	Urban and Environmental Planning	1/3
CE 3074	Environmental Analysis	1/3
CE 4007	Matrix Analysis of Structures	1/3
CE 4060	Environmental Engineering Laboratory	1/3
CE 4061	Hydrology	1/3
CE 4063/CHE 4063	Transport & Transformations in the Environment	1/3
CE 4071	Land Use Development and Controls	1/3
CE 4600	Hazardous and Industrial Waste Management	1/3
CE 4610	Solid Waste Engineering	1/3

Chemistry and Biochemistry (CH) Courses

Item #	Title	Units
BB 4170/CH 4170	Experimental Genetic Engineering	1/3
BB 4190/CH 4190	Regulation of Gene Expression	1/3
CH 1010	Chemical Properties, Bonding, and Forces	1/3
CH 1020	Chemical Reactions	1/3
CH 1030	Kinetics, Equilibrium and Thermodynamics	1/3
CH 1040	Spectroscopy in Organic and Polymer Chemistry	1/3
CH 2310	Organic Chemistry I	1/3
CH 2320	Organic Chemistry II	1/3
CH 2330	Organic Chemistry III	1/3
CH 2360	Organic Laboratory	1/3
CH 2640	Experimental Chemistry I: Instrumental Analysis	1/3
CH 2650	Modern Physical Chemistry Methods	1/3
CH 2660	Organic Synthesis and Analysis Laboratory	1/3
CH 2670	Investigation of Coordination Complexes Through Inquiry	1/3
CH 3310	Advanced Organic Chemistry	1/3
CH 3410	Structure, Bonding, and Reactivity in Inorganic Chemistry	1/3
CH 3510	Chemical Thermodynamics	1/3
CH 3530	Quantum Chemistry	1/3
CH 3550	Chemical Dynamics	1/3
CH 4110	Protein Structure and Function	1/3
CH 4120	Lipids and Biomembrane Functions	1/3
CH 4130	Nucleic Acids and Bioinformation	1/3
CH 4140	Metabolism and Disease	1/3
CH 4150	Enzymology and Protein Characterization Laboratory	1/3
CH 4160	Membrane Biophysics	1/3
CH 4330	Organic Synthesis	1/3
CH 4420	Principles and Applications of Group Theory in Chemistry	1/3
CH 4520	Chemical Statistical Mechanics	1/3

Chemical Engineering (CHE) Courses

Item #	Title	Units
CE 4063/CHE 4063	Transport & Transformations in the Environment	1/3
CHE 1011	Introduction to Chemical Engineering	1/3
CHE 2011	Chemical Engineering Fundamentals	1/3
CHE 2012	Elementary Chemical Processes	1/3
CHE 2013	Applied Chemical Engineering Thermodynamics	1/3
CHE 2014	Advanced Chemical Processes	1/3
CHE 3201	Kinetics and Reactor Design	1/3
CHE 3301	Introduction to Biological Engineering	1/3
CHE 3501	Applied Mathematics in Chemical Engineering	1/3
CHE 3702	Energy Challenges in the 21st Century	1/3
CHE 3722	Bioenergy	1/3
CHE 4401	Unit Operations of Chemical Engineering I	1/3
CHE 4402	Unit Operations of Chemical Engineering II	1/3
CHE 4403	Chemical Engineering Design	1/3
CHE 4404	Chemical Plant Design Project	1/3
CHE 4405	Chemical Process Dynamics and Control Laboratory	1/3
CHE 4410	Chemical Process Safety Design	1/3

Computer Science (CS) Courses

(Note: CS 2022 and CS 3043 cannot be used to satisfy this requirement)

Item #	Title	Units
BCB 4002/CS 4802	Biovisualization	1/3
BCB 4003/CS 4803	Biological and Biomedical Database Mining	1/3
CS 1004	Introduction to Programming for Non-Majors	1/3
CS 1101	Introduction to Program Design	1/3
CS 1102	Accelerated Introduction to Program Design	1/3
CS 2011	Introduction to Machine Organization and Assembly Language	1/3
CS 2022/MA 2201	Discrete Mathematics	1/3
CS 2102	Object-Oriented Design Concepts	1/3
CS 2103	Accelerated Object-Oriented Design Concepts	1/3
CS 2119	Application Building with Object-Oriented Concepts	1/3
CS 2223	Algorithms	1/3
CS 2301	Systems Programming for Non-Majors	1/3
CS 2303	Systems Programming Concepts	1/3
CS 3013	Operating Systems	1/3
CS 3041	Human-Computer Interaction	1/3
CS 3043	Social Implications of Information Processing	1/3
CS 3133	Foundations of Computer Science	1/3
CS 3431	Database Systems I	1/3
CS 3516	Computer Networks	1/3
CS 3733	Software Engineering	1/3
CS 4032/MA 3257	Numerical Methods for Linear and Nonlinear Systems	1/3
CS 4033/MA 3457	Numerical Methods for Calculus and Differential Equations	1/3
CS 4099	Special Topics in Computer Science	1/3
CS 4100/IMGD 4100	Artificial Intelligence for Interactive Media and Games	1/3
CS 4120	Analysis of Algorithms	1/3
CS 4123	Theory of Computation	1/3
CS 4233	Object-Oriented Analysis and Design	1/3
CS 4241	Webware: Computational Technology for Network Information Systems	1/3
CS 4300/IMGD 4300	Graphics, Simulation, and Aesthetics	1/3
CS 4341	Introduction to Artificial Intelligence	1/3
CS 4342	Machine Learning	1/3
CS 4401	Software Security Engineering	1/3
CS 4404	Tools and Techniques in Computer Network Security	1/3
CS 4432	Database Systems II	1/3
CS 4433/DS 4433	Big Data Management and Analytics	1/3
CS 4445	Data Mining and Knowledge Discovery in Databases	1/3
CS 4513	Distributed Computing Systems	1/3
CS 4515	Computer Architecture	1/3
CS 4516	Advanced Computer Networks	1/3
CS 4518	Mobile and Ubiquitous Computing	1/3
CS 4533	Techniques of Programming Language Translation	1/3
CS 4536	Programming Languages	1/3
CS 4731	Computer Graphics	1/3
CS 4732	Computer Animation	1/3
CS 4801/ECE 4802	Introduction to Cryptography and Communication Security	1/3
CS 4804	Data Visualization	1/3
MA 3457/CS 4033	Numerical Methods for Calculus and Differential Equations	1/3

Data Science (DS) Courses

Item #	Title	Units
CS 4433/DS 4433	Big Data Management and Analytics	1/3
CS 4804	Data Visualization	1/3
DS 1010	Data Science I: Introduction to Data Science	1/3
DS 2010	Data Science II: Modeling and Data Analysis	1/3
DS 3010	Data Science III: Computational Data Intelligence	1/3
DS 4635/MA 4635	Data Analytics and Statistical Learning	1/3

Electrical and Computer Engineering (ECE) Courses

Item #	Title	Units
BME 4011/ECE 4011	Biomedical Signal Analysis	1/3
BME 4023/ECE 4023	Biomedical Instrumentation Design	1/3
CS 4801/ECE 4802	Introduction to Cryptography and Communication Security	1/3
ECE 1799	Frontiers and Current Issues of Electrical and Computer Engineering	1/6
ECE 2010	Introduction to Electrical and Computer Engineering	1/3
ECE 2019	Sensors, Circuits, and Systems	1/3
ECE 2029	Introduction to Digital Circuit Design	1/3
ECE 2049	Embedded Computing in Engineering Design	1/3
ECE 2112	Electromagnetic Fields	1/3
ECE 2201	Microelectronic Circuits I	1/3
ECE 2305	Introduction to Communications and Networks	1/3
ECE 2311	Continuous-Time Signal and System Analysis	1/3
ECE 2312	Discrete-Time Signal and System Analysis	1/3
ECE 2799	Electrical and Computer Engineering Design	1/3
ECE 3012	Introduction to Control Systems Engineering	1/3
ECE 3113	Introduction to RF Circuit Design	1/3
ECE 3204	Microelectronic Circuits II	1/3
ECE 3308	Introduction to Wireless Networks	1/3
ECE 3311	Principles of Communication Systems	1/3
ECE 3500	Electric Power and Renewable Energy Systems	1/3
ECE 3501	Electromechanical Energy Systems	1/3
ECE 3829	Advanced Digital System Design with FPGAs	1/3
ECE 3849	Real-Time Embedded Systems	1/3
ECE 4305	Software-Defined Radio Systems and Analysis	1/3
ECE 4503	Power Electronics And Power Management	1/3
ECE 4703	Real-Time Digital Signal Processing	1/3
ECE 4801	Computer Organization and Design	1/3
ECE 4902	Analog Integrated Circuit Design	1/3
ECE 4904	Semiconductor Devices	1/3

Engineering Science Interdisciplinary (ES) Courses

Item #	Title	Units
ES 1020	Introduction to Engineering	1/3
ES 1310	Introduction to Computer Aided Design	1/3
ES 1500	Fundamentals of Systems Thinking	1/3
ES 2001	Introduction to Materials Science	1/3
ES 2501	Introduction to Static Systems	1/3
ES 2502	Stress Analysis	1/3
ES 2503	Introduction to Dynamic Systems	1/3
ES 2800	Environmental Impacts of Engineering Decisions	1/3
ES 3001	Introduction to Thermodynamics	1/3
ES 3002	Mass Transfer	1/3
ES 3003	Heat Transfer	1/3
ES 3004	Fluid Mechanics	1/3
ES 3011	Control Engineering I	1/3
ES 3323	Advanced Computer Aided Design	1/3
ES 3501	A Project-Based Introduction to Systems Engineering	1/3

Geosciences (GE) Courses

Item #	Title	Units
GE 2341	Geology	1/3

Mathematics (MA) Courses

Item #	Title	Units
BCB 4004/MA 4603	Statistical Methods in Genetics and Bioinformatics	1/3
CS 2022/MA 2201	Discrete Mathematics	1/3
CS 4032/MA 3257	Numerical Methods for Linear and Nonlinear Systems	1/3
CS 4033/MA 3457	Numerical Methods for Calculus and Differential Equations	1/3
DS 4635/MA 4635	Data Analytics and Statistical Learning	1/3
MA 1020	Calculus I with Preliminary Topics	1/3
MA 1021	Calculus I	1/3
MA 1022	Calculus II	1/3
MA 1023	Calculus III	1/3
MA 1024	Calculus IV	1/3
MA 1033	Theoretical Calculus III	1/3
MA 1034	Theoretical Calculus IV	1/3
MA 1120	Calculus II (Semester Version)	1/3
MA 1801	Denksport	1/12
MA 1971	Bridge to Higher Mathematics	1/3
MA 2051	Ordinary Differential Equations	1/3
MA 2071	Matrices and Linear Algebra I	1/3
MA 2072	Accelerated Matrices and Linear Algebra I	1/3
MA 2073	Matrices and Linear Algebra II	1/3
MA 2210	Mathematical Methods in Decision Making	1/3
MA 2211	Theory of Interest I	1/3
MA 2212	Theory of Interest II	1/3
MA 2251	Vector and Tensor Calculus	1/3
MA 2271	Graph Theory	1/3
MA 2273	Combinatorics	1/3
MA 2431	Mathematical Modeling with Ordinary Differential Equations	1/3
MA 2610	Applied Statistics for the Life Sciences	1/3
MA 2611	Applied Statistics I	1/3
MA 2612	Applied Statistics II	1/3
MA 2621	Probability for Applications	1/3
MA 2631	Probability Theory	1/3
MA 3212	Actuarial Mathematics I	1/3
MA 3213	Actuarial Mathematics II	1/3
MA 3231	Linear Programming	1/3
MA 3233	Discrete Optimization	1/3
MA 3457/CS 4033	Numerical Methods for Calculus and Differential Equations	1/3
MA 3471	Advanced Ordinary Differential Equations	1/3
MA 3475	Calculus of Variations	1/3
MA 3627	Introduction to the Design and Analysis of Experiments	1/3
MA 3631	Mathematical Statistics	1/3
MA 3823	Group Theory	1/3
MA 3825	Rings and Fields	1/3
MA 3831	Principles of Real Analysis I	1/3
MA 3832	Principles of Real Analysis II	1/3
MA 4213	Loss Models I - Risk Theory	1/3
MA 4214	Loss Models II - Survival Models	1/3
MA 4216	Actuarial Seminar	
MA 4222	Top Algorithms in Applied Mathematics	1/3
MA 4235	Mathematical Optimization	1/3
MA 4237	Probabilistic Methods in Operations Research	1/3
MA 4291	Applied Complex Variables	1/3
MA 4411	Numerical Analysis of Differential Equations	1/3
MA 4451	Boundary Value Problems	1/3

MA 4473	Partial Differential Equations	1/3
MA 4631	Probability and Mathematical Statistics I	1/3
MA 4632	Probability and Mathematical Statistics II	1/3
MA 4891	Topics in Mathematics	1/3
MA 4892	Topics in Actuarial Mathematics	1/3
MA 4895	Differential Geometry	1/3

Mechanical Engineering (ME) Courses

Item #	Title	Units
BME 4504/ME 4504	Biomechanics	1/3
BME 4606/ME 4606	Biofluids	1/3
BME 4814/ME 4814	Biomaterials	1/3
ME 1520	The Technology of Alpine SkIIng	1/3
ME 1800	Manufacturing Science, Prototyping, and Computer-Controlled Machining	1/3
ME 2300	Introduction to Engineering Design	1/3
ME 2312	Introduction to Computational Solutions for Engineering Problems	1/3
ME 2820	Materials Processing	1/3
ME 3310	Kinematics of Mechanisms	1/3
ME 3311	Dynamics of Mechanisms and Machines	1/3
ME 3320	Design of Machine Elements	1/3
ME 3411	Intermediate Fluid Mechanics	1/3
ME 3501	Elementary Continuum Mechanics	1/3
ME 3506	Rehabilitation Engineering	1/3
ME 3820	Computer-Aided Manufacturing	1/3
ME 3901	Engineering Experimentation	1/3
ME 3902	Project-Based Engineering Experimentation	1/3
ME 4320	Advanced Engineering Design	1/3
ME 4323	Fundamentals of Drivetrain Systems	1/3
ME 4324	Integrated Design of Mechanical Systems	1/3
ME 4422	Design and Optimization of Thermal Systems	1/3
ME 4424	Radiation Heat Transfer Application and Design	1/3
ME 4429	Thermofluid Application and Design	1/3
ME 4430	Integrated Thermomechanical Design and Analysis	1/3
ME 4505	Advanced Dynamics	1/3
ME 4506	Mechanical Vibrations	1/3
ME 4512	Introduction to the Finite Element Method	1/3
ME 4710	Gas Turbines for Propulsion and Power Generation	1/3
ME 4813	Ceramics and Glasses for Engineering Applications	1/3
ME 4821	Plastics	1/3
ME 4832	Corrosion and Corrosion Control	1/3
ME 4840	Physical Metallurgy	1/3
ME 4875/MTE 575	Introduction to Nanomaterials and Nanotechnology	1/3
RBE 4322/ME 4322	Modeling and Analysis of Mechatronic Systems	1/3

Physics (PH) Courses

Item #	Title	Units
PH 1110	General Physics—Mechanics	1/3
PH 1111	Principles of Physics—Mechanics	1/3
PH 1120	General Physics—Electricity and Magnetism	1/3
PH 1121	Principles of Physics—Electricity and Magnetism	1/3
PH 1130	Modern Physics	1/3
PH 1140	Oscillations and Waves	1/3
PH 1150	Introductory Physics of Living Systems	1/3
PH 2101	Principles of Thermodynamics	1/3
PH 2201	Intermediate Mechanics I	1/3
PH 2202	Intermediate Mechanics II	1/3
PH 2301	Electromagnetic Fields	1/3
PH 2501	Photonics	1/3
PH 2502	Lasers	1/3
PH 2510	Atomic Force Microscopy	1/3
PH 2520	Introduction to Astrophysics	1/3
PH 2540	Solar Systems	1/3
PH 2550/AE 2550	Atmospheric and Space Environments	1/3
PH 2601	Photonics Laboratory	1/3
PH 2651	Intermediate Physics Laboratory	1/3
PH 3206	Statistical Physics	1/3
PH 3301	Electromagnetic Theory	1/3
PH 3401	Quantum Mechanics I	1/3
PH 3402	Quantum Mechanics II	1/3
PH 3501	Relativity	1/3
PH 3502	Solid State Physics	1/3
PH 3503	Nuclear Physics	1/3
PH 3504	Optics	1/3
PH 4201/PH 511	Advanced Classical Mechanics	1/3

Robotics Engineering (RBE) Courses

Item #	Title	Units
RBE 1001	Introduction to Robotics	1/3
RBE 2001	Unified Robotics I: Actuation	1/3
RBE 2002	Unified Robotics II: Sensing	1/3
RBE 3001	Unified Robotics III: Manipulation	1/3
RBE 3002	Unified Robotics IV: Navigation	1/3
RBE 3100	Social Implications of Robotics	1/3
RBE 4322/ME 4322	Modeling and Analysis of Mechatronic Systems	1/3
RBE 4540	Vision-based Robotic Manipulation	1/3
RBE 4815	Industrial Robotics	1/3

Mathematics and Data Analysis (Minimum 1/3 Units)

Choose 1/3 unit from the options below. (IMGD 2905, Any course with a DS or MA prefix)

Item #	Title	Units
IMGD 2905	Data Analysis for Game Development	1/3
BCB 4004/MA 4603	Statistical Methods in Genetics and Bioinformatics	1/3
CS 2022/MA 2201	Discrete Mathematics	1/3
CS 4032/MA 3257	Numerical Methods for Linear and Nonlinear Systems	1/3
CS 4033/MA 3457	Numerical Methods for Calculus and Differential Equations	1/3
CS 4433/DS 4433	Big Data Management and Analytics	1/3
CS 4804	Data Visualization	1/3
DS 1010	Data Science I: Introduction to Data Science	1/3
DS 2010	Data Science II: Modeling and Data Analysis	1/3
DS 3010	Data Science III: Computational Data Intelligence	1/3
DS 4635/MA 4635	Data Analytics and Statistical Learning	1/3
MA 1020	Calculus I with Preliminary Topics	1/3
MA 1021	Calculus I	1/3
MA 1022	Calculus II	1/3
MA 1023	Calculus III	1/3
MA 1024	Calculus IV	1/3
MA 1033	Theoretical Calculus III	1/3
MA 1034	Theoretical Calculus IV	1/3
MA 1120	Calculus II (Semester Version)	1/3
MA 1801	Denksport	1/12
MA 1971	Bridge to Higher Mathematics	1/3
MA 2051	Ordinary Differential Equations	1/3
MA 2071	Matrices and Linear Algebra I	1/3
MA 2072	Accelerated Matrices and Linear Algebra I	1/3
MA 2073	Matrices and Linear Algebra II	1/3
MA 2210	Mathematical Methods in Decision Making	1/3
MA 2211	Theory of Interest I	1/3
MA 2212	Theory of Interest II	1/3
MA 2251	Vector and Tensor Calculus	1/3
MA 2271	Graph Theory	1/3
MA 2273	Combinatorics	1/3
MA 2431	Mathematical Modeling with Ordinary Differential Equations	1/3
MA 2610	Applied Statistics for the Life Sciences	1/3
MA 2611	Applied Statistics I	1/3
MA 2612	Applied Statistics II	1/3
MA 2621	Probability for Applications	1/3
MA 2631	Probability Theory	1/3
MA 3212	Actuarial Mathematics I	1/3
MA 3213	Actuarial Mathematics II	1/3
MA 3231	Linear Programming	1/3
MA 3233	Discrete Optimization	1/3
MA 3457/CS 4033	Numerical Methods for Calculus and Differential Equations	1/3
MA 3471	Advanced Ordinary Differential Equations	1/3
MA 3475	Calculus of Variations	1/3
MA 3627	Introduction to the Design and Analysis of Experiments	1/3
MA 3631	Mathematical Statistics	1/3
MA 3823	Group Theory	1/3
MA 3825	Rings and Fields	1/3
MA 3831	Principles of Real Analysis I	1/3
MA 3832	Principles of Real Analysis II	1/3
MA 4213	Loss Models I - Risk Theory	1/3
MA 4214	Loss Models II - Survival Models	1/3
MA 4216	Actuarial Seminar	

MA 4222	Top Algorithms in Applied Mathematics	1/3
MA 4235	Mathematical Optimization	1/3
MA 4237	Probabilistic Methods in Operations Research	1/3
MA 4291	Applied Complex Variables	1/3
MA 4411	Numerical Analysis of Differential Equations	1/3
MA 4451	Boundary Value Problems	1/3
MA 4473	Partial Differential Equations	1/3
MA 4631	Probability and Mathematical Statistics I	1/3
MA 4632	Probability and Mathematical Statistics II	1/3
MA 4891	Topics in Mathematics	1/3
MA 4892	Topics in Actuarial Mathematics	1/3
MA 4895	Differential Geometry	1/3

Computer Science (Minimum 2/3 Units)

Choose from any course with a CS prefix (except CS 2022 or CS 3043).

Item #	Title	Units
BCB 4002/CS 4802	Biovisualization	1/3
BCB 4003/CS 4803	Biological and Biomedical Database Mining	1/3
CS 1004	Introduction to Programming for Non-Majors	1/3
CS 1101	Introduction to Program Design	1/3
CS 1102	Accelerated Introduction to Program Design	1/3
CS 2011	Introduction to Machine Organization and Assembly Language	1/3
CS 2022/MA 2201	Discrete Mathematics	1/3
CS 2102	Object-Oriented Design Concepts	1/3
CS 2103	Accelerated Object-Oriented Design Concepts	1/3
CS 2119	Application Building with Object-Oriented Concepts	1/3
CS 2223	Algorithms	1/3
CS 2301	Systems Programming for Non-Majors	1/3
CS 2303	Systems Programming Concepts	1/3
CS 3013	Operating Systems	1/3
CS 3041	Human-Computer Interaction	1/3
CS 3043	Social Implications of Information Processing	1/3
CS 3133	Foundations of Computer Science	1/3
CS 3431	Database Systems I	1/3
CS 3516	Computer Networks	1/3
CS 3733	Software Engineering	1/3
CS 4032/MA 3257	Numerical Methods for Linear and Nonlinear Systems	1/3
CS 4033/MA 3457	Numerical Methods for Calculus and Differential Equations	1/3
CS 4099	Special Topics in Computer Science	1/3
CS 4100/IMGD 4100	Artificial Intelligence for Interactive Media and Games	1/3
CS 4120	Analysis of Algorithms	1/3
CS 4123	Theory of Computation	1/3
CS 4233	Object-Oriented Analysis and Design	1/3
CS 4241	Webware: Computational Technology for Network Information Systems	1/3
CS 4300/IMGD 4300	Graphics, Simulation, and Aesthetics	1/3
CS 4341	Introduction to Artificial Intelligence	1/3
CS 4342	Machine Learning	1/3
CS 4401	Software Security Engineering	1/3
CS 4404	Tools and Techniques in Computer Network Security	1/3
CS 4432	Database Systems II	1/3
CS 4433/DS 4433	Big Data Management and Analytics	1/3
CS 4445	Data Mining and Knowledge Discovery in Databases	1/3
CS 4513	Distributed Computing Systems	1/3
CS 4515	Computer Architecture	1/3
CS 4516	Advanced Computer Networks	1/3
CS 4518	Mobile and Ubiquitous Computing	1/3
CS 4533	Techniques of Programming Language Translation	1/3
CS 4536	Programming Languages	1/3
CS 4731	Computer Graphics	1/3
CS 4732	Computer Animation	1/3
CS 4801/ECE 4802	Introduction to Cryptography and Communication Security	1/3
CS 4804	Data Visualization	1/3
MA 3457/CS 4033	Numerical Methods for Calculus and Differential Equations	1/3

General IMGD (Minimum 8/3 Units)

Choose from any course with an IMGD prefix, which must include:

Any 1000+ level IMGD courses (Minimum 1/3 Units)

Item #	Title	Units
AR 2048/IMGD 2048	Technical Art and Character Rigging	1/3
AR 2101/IMGD 2101	3D Modeling I	1/3
AR 2222/IMGD 2222	2D Animation I	1/3
AR 2333/IMGD 2333	3D Animation I	1/3
AR 2700/IMGD 2700	Digital Painting	1/3
AR 2740/IMGD 2740	3D Environmental Modeling	1/3
AR 3101/IMGD 3101	3D Modeling II	1/3
AR 3200/IMGD 3200	Interactive Electronic Arts	1/3
AR 3210/IMGD 3210	Human Figure in Motion	1/3
AR 3222/IMGD 3222	2D Animation II	1/3
AR 3333/IMGD 3333	3D Animation II	1/3
AR 3700/IMGD 3700	Concept Art and Creative Illustration	1/3
CS 4100/IMGD 4100	Artificial Intelligence for Interactive Media and Games	1/3
CS 4300/IMGD 4300	Graphics, Simulation, and Aesthetics	1/3
IMGD 1000	Critical Studies of Interactive Media and Games	1/3
IMGD 1001	The Game Development Process	1/3
IMGD 1002	Storytelling in Interactive Media and Games	1/3
IMGD 2000	Social Issues in Interactive Media and Games	1/3
IMGD 2001	Philosophy and Ethics of Computer Games	1/3
IMGD 2030	Game Audio I	1/3
IMGD 2450/WR 2450	Narrative Design for Interactive Media and Games	1/3
IMGD 2500	Design of Tabletop Strategy Games	1/3
IMGD 2900	Digital Game Design I	1/3
IMGD 2905	Data Analysis for Game Development	1/3
IMGD 3000	Technical Game Development I	1/3
IMGD 3030	Game Audio II	1/3
IMGD 3100	Novel Interfaces for Interactive Environments	1/3
IMGD 3450/WR 3450	Writing Characters for Interactive Media & Games	1/3
IMGD 3500	Artistic Game Development I	1/3
IMGD 3900	Digital Game Design II	1/3
IMGD 4000	Technical Game Development II	1/3
IMGD 4030	Advanced Topics in Interactive Audio	1/3
IMGD 4099	Special Topics in IMGD	1/6
IMGD 4200	History and Future of Immersive and Interactive Media	1/3
IMGD 4403	Motion Capture Techniques	1/3
IMGD 4500	Artistic Game Development II	1/3
IMGD 4600	Serious Games	1/3
IMGD 4700	Advanced Storytelling: Quest Logic and Level Design	1/3
IMGD 4900	Digital Game Design Studio	1/3

Any 2000+ level IMGD course (Minimum 3/3 Units)

Item #	Title	Units
AR 2048/IMGD 2048	Technical Art and Character Rigging	1/3
AR 2101/IMGD 2101	3D Modeling I	1/3
AR 2222/IMGD 2222	2D Animation I	1/3
AR 2333/IMGD 2333	3D Animation I	1/3
AR 2700/IMGD 2700	Digital Painting	1/3
AR 2740/IMGD 2740	3D Environmental Modeling	1/3
AR 3101/IMGD 3101	3D Modeling II	1/3
AR 3200/IMGD 3200	Interactive Electronic Arts	1/3
AR 3210/IMGD 3210	Human Figure in Motion	1/3
AR 3222/IMGD 3222	2D Animation II	1/3
AR 3333/IMGD 3333	3D Animation II	1/3
AR 3700/IMGD 3700	Concept Art and Creative Illustration	1/3
CS 4100/IMGD 4100	Artificial Intelligence for Interactive Media and Games	1/3
CS 4300/IMGD 4300	Graphics, Simulation, and Aesthetics	1/3
IMGD 2000	Social Issues in Interactive Media and Games	1/3
IMGD 2001	Philosophy and Ethics of Computer Games	1/3
IMGD 2030	Game Audio I	1/3
IMGD 2450/WR 2450	Narrative Design for Interactive Media and Games	1/3
IMGD 2500	Design of Tabletop Strategy Games	1/3
IMGD 2900	Digital Game Design I	1/3
IMGD 2905	Data Analysis for Game Development	1/3
IMGD 3000	Technical Game Development I	1/3
IMGD 3030	Game Audio II	1/3
IMGD 3100	Novel Interfaces for Interactive Environments	1/3
IMGD 3450/WR 3450	Writing Characters for Interactive Media & Games	1/3
IMGD 3500	Artistic Game Development I	1/3
IMGD 3900	Digital Game Design II	1/3
IMGD 4000	Technical Game Development II	1/3
IMGD 4030	Advanced Topics in Interactive Audio	1/3
IMGD 4099	Special Topics in IMGD	1/6
IMGD 4200	History and Future of Immersive and Interactive Media	1/3
IMGD 4403	Motion Capture Techniques	1/3
IMGD 4500	Artistic Game Development II	1/3
IMGD 4600	Serious Games	1/3
IMGD 4700	Advanced Storytelling: Quest Logic and Level Design	1/3
IMGD 4900	Digital Game Design Studio	1/3

Any 3000+ level IMGD courses (Minimum 2/3 Units)

Item #	Title	Units
AR 3101/IMGD 3101	3D Modeling II	1/3
AR 3200/IMGD 3200	Interactive Electronic Arts	1/3
AR 3210/IMGD 3210	Human Figure in Motion	1/3
AR 3222/IMGD 3222	2D Animation II	1/3
AR 3333/IMGD 3333	3D Animation II	1/3
AR 3700/IMGD 3700	Concept Art and Creative Illustration	1/3
CS 4100/IMGD 4100	Artificial Intelligence for Interactive Media and Games	1/3
CS 4300/IMGD 4300	Graphics, Simulation, and Aesthetics	1/3
IMGD 3000	Technical Game Development I	1/3
IMGD 3030	Game Audio II	1/3
IMGD 3100	Novel Interfaces for Interactive Environments	1/3
IMGD 3450/WR 3450	Writing Characters for Interactive Media & Games	1/3
IMGD 3500	Artistic Game Development I	1/3
IMGD 3900	Digital Game Design II	1/3
IMGD 4000	Technical Game Development II	1/3
IMGD 4030	Advanced Topics in Interactive Audio	1/3
IMGD 4099	Special Topics in IMGD	1/6
IMGD 4200	History and Future of Immersive and Interactive Media	1/3
IMGD 4403	Motion Capture Techniques	1/3
IMGD 4500	Artistic Game Development II	1/3
IMGD 4600	Serious Games	1/3
IMGD 4700	Advanced Storytelling: Quest Logic and Level Design	1/3
IMGD 4900	Digital Game Design Studio	1/3

Any 4000+ level IMGD courses (Minimum 2/3 Units)

Item #	Title	Units
CS 4100/IMGD 4100	Artificial Intelligence for Interactive Media and Games	1/3
CS 4300/IMGD 4300	Graphics, Simulation, and Aesthetics	1/3
IMGD 4000	Technical Game Development II	1/3
IMGD 4030	Advanced Topics in Interactive Audio	1/3
IMGD 4099	Special Topics in IMGD	1/6
IMGD 4200	History and Future of Immersive and Interactive Media	1/3
IMGD 4403	Motion Capture Techniques	1/3
IMGD 4500	Artistic Game Development II	1/3
IMGD 4600	Serious Games	1/3
IMGD 4700	Advanced Storytelling: Quest Logic and Level Design	1/3
IMGD 4900	Digital Game Design Studio	1/3

IMGD Focus Pair (Minimum 2/3 Units)

Choose from one of the following IMGD course pairs

Technical Art

Item #	Title	Units
IMGD 3000	Technical Game Development I	1/3
IMGD 4000	Technical Game Development II	1/3

Visual Art

Item #	Title	Units
IMGD 3500	Artistic Game Development I	1/3
IMGD 4500	Artistic Game Development II	1/3

Design

Item #	Title	Units
IMGD 3900	Digital Game Design II	1/3
IMGD 4900	Digital Game Design Studio	1/3

Writing

Item #	Title	Units
IMGD 2450/WR 2450	Narrative Design for Interactive Media and Games	1/3
IMGD 4700	Advanced Storytelling: Quest Logic and Level Design	1/3

IMGD Electives (Minimum 4/3 Units)

Choose from any courses with an AR, CS (except CS 2022 or CS 3043), DS, EN, IMGD, MA, MU or WR prefix, at least 2/3 of which must be 3000+ level.

Art History/Architecture (AR) Courses

Item #	Title	Units
AR 1100	Essentials of Art	1/3
AR 1101	Digital Imaging and Computer Art	1/3
AR 1111	Introduction to Art History	1/3
AR 2048/IMGD 2048	Technical Art and Character Rigging	1/3
AR 2101/IMGD 2101	3D Modeling I	1/3
AR 2111	Modern Art	1/3
AR 2114	Modern Architecture in the American Era, 1750-2001 and Beyond	1/3
AR 2115	Topics in Architecture Since 1960	1/3
AR 2202	Figure Drawing	1/3
AR 2222/IMGD 2222	2D Animation I	1/3
AR 2301	Graphic Design	1/3
AR 2333/IMGD 2333	3D Animation I	1/3
AR 2401	Video Production	1/3
AR 2700/IMGD 2700	Digital Painting	1/3
AR 2740/IMGD 2740	3D Environmental Modeling	1/3
AR 2750	Topics in Studio Art	1/3
AR 3101/IMGD 3101	3D Modeling II	1/3
AR 3112	Modernism, Mass Culture, and the Avant-Garde	1/3
AR 3150/ID 3150	Light, Vision and Understanding	1/3
AR 3200/IMGD 3200	Interactive Electronic Arts	1/3
AR 3210/IMGD 3210	Human Figure in Motion	1/3
AR 3222/IMGD 3222	2D Animation II	1/3
AR 3333/IMGD 3333	3D Animation II	1/3
AR 3700/IMGD 3700	Concept Art and Creative Illustration	1/3

Computer Science (CS) Courses

Note: CS 2022 and CS 3043 cannot be used to satisfy the IMGD Elective requirement.

Item #	Title	Units
BCB 4002/CS 4802	Biovisualization	1/3
BCB 4003/CS 4803	Biological and Biomedical Database Mining	1/3
CS 1004	Introduction to Programming for Non-Majors	1/3
CS 1101	Introduction to Program Design	1/3
CS 1102	Accelerated Introduction to Program Design	1/3
CS 2011	Introduction to Machine Organization and Assembly Language	1/3
CS 2022/MA 2201	Discrete Mathematics	1/3
CS 2102	Object-Oriented Design Concepts	1/3
CS 2103	Accelerated Object-Oriented Design Concepts	1/3
CS 2119	Application Building with Object-Oriented Concepts	1/3
CS 2223	Algorithms	1/3
CS 2301	Systems Programming for Non-Majors	1/3
CS 2303	Systems Programming Concepts	1/3
CS 3013	Operating Systems	1/3
CS 3041	Human-Computer Interaction	1/3
CS 3043	Social Implications of Information Processing	1/3
CS 3133	Foundations of Computer Science	1/3
CS 3431	Database Systems I	1/3
CS 3516	Computer Networks	1/3
CS 3733	Software Engineering	1/3
CS 4032/MA 3257	Numerical Methods for Linear and Nonlinear Systems	1/3
CS 4033/MA 3457	Numerical Methods for Calculus and Differential Equations	1/3
CS 4099	Special Topics in Computer Science	1/3
CS 4100/IMGD 4100	Artificial Intelligence for Interactive Media and Games	1/3
CS 4120	Analysis of Algorithms	1/3
CS 4123	Theory of Computation	1/3
CS 4233	Object-Oriented Analysis and Design	1/3
CS 4241	Webware: Computational Technology for Network Information Systems	1/3
CS 4300/IMGD 4300	Graphics, Simulation, and Aesthetics	1/3
CS 4341	Introduction to Artificial Intelligence	1/3
CS 4342	Machine Learning	1/3
CS 4401	Software Security Engineering	1/3
CS 4404	Tools and Techniques in Computer Network Security	1/3
CS 4432	Database Systems II	1/3
CS 4433/DS 4433	Big Data Management and Analytics	1/3
CS 4445	Data Mining and Knowledge Discovery in Databases	1/3
CS 4513	Distributed Computing Systems	1/3
CS 4515	Computer Architecture	1/3
CS 4516	Advanced Computer Networks	1/3
CS 4518	Mobile and Ubiquitous Computing	1/3
CS 4533	Techniques of Programming Language Translation	1/3
CS 4536	Programming Languages	1/3
CS 4731	Computer Graphics	1/3
CS 4732	Computer Animation	1/3
CS 4801/ECE 4802	Introduction to Cryptography and Communication Security	1/3
CS 4804	Data Visualization	1/3
MA 3457/CS 4033	Numerical Methods for Calculus and Differential Equations	1/3

Data Science (DS) Courses

Item #	Title	Units
CS 4433/DS 4433	Big Data Management and Analytics	1/3
CS 4804	Data Visualization	1/3
DS 1010	Data Science I: Introduction to Data Science	1/3
DS 2010	Data Science II: Modeling and Data Analysis	1/3
DS 3010	Data Science III: Computational Data Intelligence	1/3
DS 4635/MA 4635	Data Analytics and Statistical Learning	1/3

English (EN) Courses

Item #	Title	Units
EN 1219	Introduction to Creative Writing	1/3
EN 1221/TH 1221	Introduction to Theatre on Page and Stage	1/3
EN 1222	Shakespeare in the Age of Elizabeth	1/3
EN 1242	Introduction to English Poetry	1/3
EN 1251	Introduction to Literature	1/3
EN 1257	Introduction to African American Literature and Culture	1/3
EN 1259	Introduction to Contemporary Chicana/o Literature	1/3
EN 2219	Creative Writing	1/3
EN 2225	The Literature of Sin	1/3
EN 2226	Infected Shakespeare: Venereal Disease, Madness, Plague	1/3
EN 2234	Modern American Novel	1/3
EN 2237	Literature and the Environment	1/3
EN 2242	Popular Fiction: Reading in Installments	1/3
EN 2243	Modern British Literature	1/3
EN 2244	19th-Century English Literature	1/3
EN 2251	Moral Issues in the Modern Novel	1/3
EN 2252	Science and Scientists in Modern Literature	1/3
EN 2271	American Literary Histories	1/3
EN 2281	World Literatures	1/3
EN 2500/TH 2500	Fundamentals of Technical Theatre	1/3
EN 3219	Advanced Creative Writing	1/3
EN 3226	Strange and Strangers	1/3
EN 3231	Supernatural Literatures	1/3
EN 3234	Modern American Poetry	1/3
EN 3238	American Authors	1/3
EN 3248	The English Novel	1/3
EN 3257	Topics in African American Literature	1/3
EN 3271	American Literary Topics	1/3

Interactive Media & Game Development (IMGD) Courses

Item #	Title	Units
AR 2048/IMGD 2048	Technical Art and Character Rigging	1/3
AR 2101/IMGD 2101	3D Modeling I	1/3
AR 2222/IMGD 2222	2D Animation I	1/3
AR 2333/IMGD 2333	3D Animation I	1/3
AR 2700/IMGD 2700	Digital Painting	1/3
AR 2740/IMGD 2740	3D Environmental Modeling	1/3
AR 3101/IMGD 3101	3D Modeling II	1/3
AR 3200/IMGD 3200	Interactive Electronic Arts	1/3
AR 3210/IMGD 3210	Human Figure in Motion	1/3
AR 3222/IMGD 3222	2D Animation II	1/3
AR 3333/IMGD 3333	3D Animation II	1/3
AR 3700/IMGD 3700	Concept Art and Creative Illustration	1/3
CS 4100/IMGD 4100	Artificial Intelligence for Interactive Media and Games	1/3
CS 4300/IMGD 4300	Graphics, Simulation, and Aesthetics	1/3
IMGD 1000	Critical Studies of Interactive Media and Games	1/3
IMGD 1001	The Game Development Process	1/3
IMGD 1002	Storytelling in Interactive Media and Games	1/3
IMGD 2000	Social Issues in Interactive Media and Games	1/3
IMGD 2001	Philosophy and Ethics of Computer Games	1/3
IMGD 2030	Game Audio I	1/3
IMGD 2450/WR 2450	Narrative Design for Interactive Media and Games	1/3
IMGD 2500	Design of Tabletop Strategy Games	1/3
IMGD 2900	Digital Game Design I	1/3
IMGD 2905	Data Analysis for Game Development	1/3
IMGD 3000	Technical Game Development I	1/3
IMGD 3030	Game Audio II	1/3
IMGD 3100	Novel Interfaces for Interactive Environments	1/3
IMGD 3450/WR 3450	Writing Characters for Interactive Media & Games	1/3
IMGD 3500	Artistic Game Development I	1/3
IMGD 3900	Digital Game Design II	1/3
IMGD 4000	Technical Game Development II	1/3
IMGD 4030	Advanced Topics in Interactive Audio	1/3
IMGD 4099	Special Topics in IMGD	1/6
IMGD 4200	History and Future of Immersive and Interactive Media	1/3
IMGD 4403	Motion Capture Techniques	1/3
IMGD 4500	Artistic Game Development II	1/3
IMGD 4600	Serious Games	1/3
IMGD 4700	Advanced Storytelling: Quest Logic and Level Design	1/3
IMGD 4900	Digital Game Design Studio	1/3

Item #	Title	Units
BCB 4004/MA 4603	Statistical Methods in Genetics and Bioinformatics	1/3
CS 2022/MA 2201	Discrete Mathematics	1/3
CS 4032/MA 3257	Numerical Methods for Linear and Nonlinear Systems	1/3
CS 4033/MA 3457	Numerical Methods for Calculus and Differential Equations	1/3
DS 4635/MA 4635	Data Analytics and Statistical Learning	1/3
MA 1020	Calculus I with Preliminary Topics	1/3
MA 1021	Calculus I	1/3
MA 1022	Calculus II	1/3
MA 1023	Calculus III	1/3
MA 1024	Calculus IV	1/3
MA 1033	Theoretical Calculus III	1/3
MA 1034	Theoretical Calculus IV	1/3
MA 1120	Calculus II (Semester Version)	1/3
MA 1801	Denksport	1/12
MA 1971	Bridge to Higher Mathematics	1/3
MA 2051	Ordinary Differential Equations	1/3
MA 2071	Matrices and Linear Algebra I	1/3
MA 2072	Accelerated Matrices and Linear Algebra I	1/3
MA 2073	Matrices and Linear Algebra II	1/3
MA 2210	Mathematical Methods in Decision Making	1/3
MA 2211	Theory of Interest I	1/3
MA 2212	Theory of Interest II	1/3
MA 2251	Vector and Tensor Calculus	1/3
MA 2271	Graph Theory	1/3
MA 2273	Combinatorics	1/3
MA 2431	Mathematical Modeling with Ordinary Differential Equations	1/3
MA 2610	Applied Statistics for the Life Sciences	1/3
MA 2611	Applied Statistics I	1/3
MA 2612	Applied Statistics II	1/3
MA 2621	Probability for Applications	1/3
MA 2631	Probability Theory	1/3
MA 3212	Actuarial Mathematics I	1/3
MA 3213	Actuarial Mathematics II	1/3
MA 3231	Linear Programming	1/3
MA 3233	Discrete Optimization	1/3
MA 3457/CS 4033	Numerical Methods for Calculus and Differential Equations	1/3
MA 3471	Advanced Ordinary Differential Equations	1/3
MA 3475	Calculus of Variations	1/3
MA 3627	Introduction to the Design and Analysis of Experiments	1/3
MA 3631	Mathematical Statistics	1/3
MA 3823	Group Theory	1/3
MA 3825	Rings and Fields	1/3
MA 3831	Principles of Real Analysis I	1/3
MA 3832	Principles of Real Analysis II	1/3
MA 4213	Loss Models I - Risk Theory	1/3
MA 4214	Loss Models II - Survival Models	1/3
MA 4216	Actuarial Seminar	
MA 4222	Top Algorithms in Applied Mathematics	1/3
MA 4235	Mathematical Optimization	1/3
MA 4237	Probabilistic Methods in Operations Research	1/3
MA 4291	Applied Complex Variables	1/3
MA 4411	Numerical Analysis of Differential Equations	1/3
MA 4451	Boundary Value Problems	1/3

MA 4473	Partial Differential Equations	1/3
MA 4631	Probability and Mathematical Statistics I	1/3
MA 4632	Probability and Mathematical Statistics II	1/3
MA 4891	Topics in Mathematics	1/3
MA 4892	Topics in Actuarial Mathematics	1/3
MA 4895	Differential Geometry	1/3

Music (MU) Courses

Item #	Title	Units
MU 1511	Introduction to Music	1/3
MU 1611	Fundamentals of Music I	1/3
MU 2300	Foundations of Music Technology	1/3
MU 2501/PSY 2501	Music and Mind	1/3
MU 2611	Fundamentals of Music II	1/3
MU 2631	Glee Club	1/3
MU 2632	Alden Voices	1/3
MU 2633	Brass Ensemble	1/3
MU 2636	Concert Band	1/3
MU 2637	Orchestra	1/3
MU 2638	Chamber Choir	1/3
MU 2639	String Quartet	1/3
MU 2640	African Drumming Ensemble	1/3
MU 2641	Percussion Ensemble	1/3
MU 2642	Jazz Combo	1/3
MU 2643	Jazz Ensemble	1/3
MU 2644	Stage Band	1/3
MU 2719	Jazz History	1/3
MU 2720	Music History I: Medieval Through the Baroque	1/3
MU 2721	Music History II: Classical to the Present	1/3
MU 2722	History of American Popular Music	1/3
MU 2723	Music Composition	1/3
MU 2801	Making Music with Machines	1/3
MU 3001	World Music	1/3
MU 3002	Arranging and Orchestration	1/3
MU 3510	Music in Time of Conflict	1/3
MU 3614	Topics in Midi	1/3
MU 3615	Topics in Digital Sound	1/3
MU 3616	Topics in Interactive Programming	1/3
MU 3620	Electronic Music Composition	1/3
MU 3730	Jazz Theory	1/3
MU 4621	Independent Instruction (Lessons) in Music	1/3

Interactive Media & Game Development Technology Major

Degree Type

Bachelor of Science

Program Distribution Requirements for the IMGD Technology Major

NOTE: IMGD Technology Majors (B.S.) may not earn a double major in IMGD.

IMGD Core Requirement (Minimum 2/3 Units)

Choose 2/3 units from:

Item #	Title	Units
IMGD 1000	Critical Studies of Interactive Media and Games	1/3
IMGD 1001	The Game Development Process	1/3
IMGD 1002	Storytelling in Interactive Media and Games	1/3

IMGD Design Requirement (Minimum 1/3 Units)

Choose 1/3 unit from:

Item #	Title	Units
IMGD 2500	Design of Tabletop Strategy Games	1/3
IMGD 2900	Digital Game Design I	1/3
IMGD 3900	Digital Game Design II	1/3
IMGD 4200	History and Future of Immersive and Interactive Media	1/3
IMGD 4600	Serious Games	1/3
IMGD 4700	Advanced Storytelling: Quest Logic and Level Design	1/3
IMGD 4900	Digital Game Design Studio	1/3
IMGD 5000	Game Design Studio	1/3
IMGD 5200	History and Future of Immersive and Interactive Media	1/3
IMGD 5300	Design of Interactive Experiences	1/3
MIS 4741	User Experience and Design	1/3

NOTE: Only one of IMGD 4200 and IMGD 5200 may count towards the IMGD Design Requirement.

IMGD Audio Requirement (Minimum 1/3 Units)

Choose 1/3 unit from:

Item #	Title	Units
IMGD 2030	Game Audio I	1/3
IMGD 3030	Game Audio II	1/3

IMGD Social & Philosophical Issues Requirement (Minimum 1/3 Units)

Select 1/3 Units from the courses listed below:

Item #	Title	Units
IMGD 2000	Social Issues in Interactive Media and Games	1/3

Cultural Narratives Requirement (Minimum 1/3 Unit)

Choose 1/3 unit from any course with an EN, PY or RE prefix.

English (EN) Courses

Item #	Title	Units
EN 1219	Introduction to Creative Writing	1/3
EN 1221/TH 1221	Introduction to Theatre on Page and Stage	1/3
EN 1222	Shakespeare in the Age of Elizabeth	1/3
EN 1242	Introduction to English Poetry	1/3
EN 1251	Introduction to Literature	1/3
EN 1257	Introduction to African American Literature and Culture	1/3
EN 1259	Introduction to Contemporary Chicana/o Literature	1/3
EN 2219	Creative Writing	1/3
EN 2225	The Literature of Sin	1/3
EN 2226	Infected Shakespeare: Venereal Disease, Madness, Plague	1/3
EN 2234	Modern American Novel	1/3
EN 2237	Literature and the Environment	1/3
EN 2242	Popular Fiction: Reading in Installments	1/3
EN 2243	Modern British Literature	1/3
EN 2244	19th-Century English Literature	1/3
EN 2251	Moral Issues in the Modern Novel	1/3
EN 2252	Science and Scientists in Modern Literature	1/3
EN 2271	American Literary Histories	1/3
EN 2281	World Literatures	1/3
EN 2500/TH 2500	Fundamentals of Technical Theatre	1/3
EN 3219	Advanced Creative Writing	1/3
EN 3226	Strange and Strangers	1/3
EN 3231	Supernatural Literatures	1/3
EN 3234	Modern American Poetry	1/3
EN 3238	American Authors	1/3
EN 3248	The English Novel	1/3
EN 3257	Topics in African American Literature	1/3
EN 3271	American Literary Topics	1/3

Philosophy (PY) Courses

Item #	Title	Units
PY 1731/RE 1731	Introduction to Philosophy and Religion	1/3
PY 2711	Epistemology	1/3
PY 2712	Social and Political Philosophy	1/3
PY 2713	Bioethics	1/3
PY 2716/RE 2716	Gender, Race, and Class	1/3
PY 2717	Philosophy and the Environment	1/3
PY 2718	Existentialism and Phenomenology	1/3
PY 2719	Philosophy of Science	1/3
PY 2731/RE 2731	Ethics	1/3
PY 2734	Philosophy and Spirituality	1/3
PY 3712	Philosophy of Religion	1/3
PY 3721/RE 3721	Topics in Religion	1/3
RE 3711/PY 3711	Topics in Philosophy	1/3

Religion (RE) Courses

Item #	Title	Units
PY 1731/RE 1731	Introduction to Philosophy and Religion	1/3
PY 2716/RE 2716	Gender, Race, and Class	1/3
PY 2731/RE 2731	Ethics	1/3
PY 3721/RE 3721	Topics in Religion	1/3
RE 2721	Religion and Culture	1/3
RE 2722	Modern Problems of Belief	1/3
RE 2725	Religious and Spiritual Traditions	1/3
RE 3711/PY 3711	Topics in Philosophy	1/3
RE 3723	Religion, Gender & Sexuality	1/3

Visual Arts Requirement (Minimum 1/3 Units)

Choose 1/3 unit from:

Item #	Title	Units
AR 1100	Essentials of Art	1/3
AR 1101	Digital Imaging and Computer Art	1/3
AR 2301	Graphic Design	1/3

Natural & Engineering Sciences (Minimum 2/3 Units)

Choose 2/3 units from any course with an AE, AREN, BB, BCB, BME, CE, CH, CHE, ECE, ES, GE, ME, NEU, PH or RBE prefix.

Aerospace Engineering (AE) Courses

Item #	Title	Units
AE 2110	Introduction to Incompressible Fluid Dynamics	1/3
AE 2310	Introduction to Aerospace Control Systems	1/3
AE 2320	Introduction to Orbital Mechanics	1/3
AE 2410	Introduction to Aerospace Structures	1/3
AE 3110	Fundamentals of Compressible Fluid Dynamics	1/3
AE 3120	Fundamentals of Aerodynamics	1/3
AE 3310	Fundamentals of Navigation and Communication	1/3
AE 3420	Fundamentals of Aerospace Structures	1/3
AE 3430	Fundamentals of Composite Materials	1/3
AE 4210	Fundamentals of Air-Breathing Propulsion	1/3
AE 4220	Fundamentals of Rocket Propulsion	1/3
AE 4310	Fundamentals of Aircraft Dynamics and Control	1/3
AE 4320	Fundamentals of Spacecraft Dynamics and Control	1/3
AE 4410	Fundamentals of Structural Dynamics	1/3
AE 4510	Aircraft Design	1/3
AE 4520	Spacecraft and Mission Design	1/3
PH 2550/AE 2550	Atmospheric and Space Environments	1/3

Architectural Engineering (AREN) Courses

Item #	Title	Units
AREN 2002	Architectural Design I	1/3
AREN 2004	Architectural Design II - Light and Lighting Systems	1/3
AREN 2023	Introduction to Architectural Engineering Systems	1/3
AREN 2025	Building Electrical Systems	1/3
AREN 3002	Architectural Design III	1/3
AREN 3003	Principles of HVAC Design for Buildings	1/3
AREN 3005	Lighting Systems	1/3
AREN 3006	Advanced HVAC System Design	1/3
AREN 3020	Architectural Design IV - Building Energy Simulation	1/3
AREN 3022	Architectural Design V - Building Envelope Design	1/3
AREN 3024	Building Physics	1/3
AREN 3025	Building Energy Simulation	1/3

Biology and Biotechnology (BB) Courses

Item #	Title	Units
BB 1001	Introduction to Biology	1/3
BB 1002	Environmental Biology	1/3
BB 1003/BCB 1003	Exploring Bioinformatics and Computational Biology	1/3
BB 1025	Human Biology	1/3
BB 1035	Biotechnology	1/3
BB 1045	Biodiversity	1/3
BB 2002	Microbiology	1/3
BB 2003	Fundamentals of Microbiology	1/3
BB 2030	Plant Diversity	1/3
BB 2040	Principles of Ecology	1/3
BB 2050	Animal Behavior	1/3
BB 2550	Cell Biology	1/3
BB 2902	Enzymes, Proteins, and Purification	1/6
BB 2903	Anatomy and Physiology	1/6
BB 2904	Ecology, Environment, and Animal Behavior	1/6
BB 2915	Searching for Solutions in Soil: Microbial and Molecular Investigations	1/3
BB 2917	Hunting for Phage	1/3
BB 2920	Genetics	1/3
BB 2950	Molecular Biology	1/3
BB 3003	Medical Microbiology: Plagues of the Modern World, a Case Study Approach	1/3
BB 3010/BCB 3010	Simulation in Biology	1/3
BB 3050	Cancer Biology	1/3
BB 3080	Neurobiology	1/3
BB 3101	Human Anatomy & Physiology: Movement and Communication	1/3
BB 3102	Human Anatomy & Physiology: Transport and Maintenance	1/3
BB 3120	Plant Physiology	1/3
BB 3140	Evolution: Pattern and Process	1/3
BB 3512	Molecular Genetics Lab	1/6
BB 3513	Cell Culture Techniques for Animal Cells	1/6
BB 3515	Physiologic Systems Laboratory	1/3
BB 3517	Fermentation	1/6
BB 3519	Protein Purification	1/6
BB 3521	Microscopy	1/6
BB 3525	Plant Physiology	1/6
BB 3526	Phage Hunters: the Analysis	1/6
BB 3527	Molecular Biology and Genetic Engineering: Approaches and Applications	1/3
BB 3530	Immunotherapies: The Next Generation of Pharmaceuticals	1/3
BB 3570	Cell Culture Models for Tissue Regeneration	1/3
BB 3620	Developmental Biology	1/3
BB 3920	Immunology	1/3
BB 4150	Environmental Change: Problems and Approaches	1/3
BB 4170/CH 4170	Experimental Genetic Engineering	1/3
BB 4190/CH 4190	Regulation of Gene Expression	1/3
BB 4260	Synthetic Biology	1/3
BB 4801/BCB 4001	Bioinformatics	1/3
BB 4900	Capstone Experience in Biology and Biotechnology	1/3

Bioinformatics and Computational Biology (BCB) Courses

Item #	Title	Units
BB 1003/BCB 1003	Exploring Bioinformatics and Computational Biology	1/3
BB 3010/BCB 3010	Simulation in Biology	1/3

Biomedical Engineering (BME) Courses

Item #	Title	Units
BME 1001	Introduction to Biomedical Engineering	1/3
BME 1004	Introduction to Programming in Matlab	1/3
BME 2001	Introduction to Biomaterials	1/3
BME 2210	Biomedical Signals, Instruments and Measurements	1/3
BME 2211	Biomedical Data Analysis	1/3
BME 2502	Introduction to Biomechanics: Stress Analysis	1/3
BME 2610	Introduction to Bioprocess Engineering	1/3
BME 3012	Biomedical Sensors Laboratory	1/6
BME 3013	Biomedical Instrumentation Laboratory	1/6
BME 3014	Physiological Signals Laboratory I: Techniques	1/6
BME 3111	Physiology and Engineering	1/3
BME 3112	Human Physiology for Biomedical Engineers	1/3
BME 3300	Biomedical Engineering Design	1/3
BME 3503	Skeletal Biomechanics Laboratory	1/6
BME 3505	Solid Biomechanics Laboratory: Techniques	1/6
BME 3506	Solid Biomechanics Laboratory: Applications	1/6
BME 3605	Biotransport Laboratory II: Applications	1/6
BME 3610	Transport Analysis in Bioengineering	1/3
BME 3811	Biomaterials Lab	1/6
BME 3813	Cellular Engineering Lab	1/6
BME 4011/ECE 4011	Biomedical Signal Analysis	1/3
BME 4023/ECE 4023	Biomedical Instrumentation Design	1/3
BME 4201	Biomedical Imaging	1/3
BME 4300	MQP Capstone Design	1/6
BME 4503	Computational Biomechanics	1/3
BME 4504/ME 4504	Biomechanics	1/3
BME 4606/ME 4606	Biofluids	1/3
BME 4701	Cell and Molecular Bioengineering	1/3
BME 4814/ME 4814	Biomaterials	1/3
BME 4828	Biomaterials-Tissue Interactions	1/3
BME 4831	Drug Delivery	1/3

Civil and Environmental Engineering (CE) Courses

Item #	Title	Units
CE 1030	Civil Engineering and Computer Fundamentals	1/3
CE 2000	Analytical Mechanics I	1/3
CE 2001	Analytical Mechanics II	1/3
CE 2002	Introduction to Analysis and Design	1/3
CE 2020	Surveying	1/3
CE 3006	Design of Steel Structures	1/3
CE 3008	Design of Reinforced Concrete Structures	1/3
CE 3010	Structural Engineering	1/3
CE 3020	Project Management	1/3
CE 3022	Legal Aspects of Professional Practice	1/3
CE 3025	Project Evaluation	1/3
CE 3026	Materials of Construction	1/3
CE 3030	Fundamentals of Civil Engineering Autocad	1/3
CE 3031	Building Information Modeling: Software Tools and Principles	1/3
CE 3041	Soil Mechanics	1/3
CE 3044	Foundation Engineering	1/3
CE 3050	Traffic Engineering	1/3
CE 3051	Pavement Engineering	1/3
CE 3059	Environmental Engineering	1/3
CE 3060	Water Treatment	1/3
CE 3061	Sustainable Wastewater Engineering: Treatment and Reuse	1/3
CE 3062	Hydraulics	1/3
CE 3070	Urban and Environmental Planning	1/3
CE 3074	Environmental Analysis	1/3
CE 4007	Matrix Analysis of Structures	1/3
CE 4060	Environmental Engineering Laboratory	1/3
CE 4061	Hydrology	1/3
CE 4063/CHE 4063	Transport & Transformations in the Environment	1/3
CE 4071	Land Use Development and Controls	1/3
CE 4600	Hazardous and Industrial Waste Management	1/3
CE 4610	Solid Waste Engineering	1/3

Chemistry and Biochemistry (CH) Courses

Item #	Title	Units
BB 4170/CH 4170	Experimental Genetic Engineering	1/3
BB 4190/CH 4190	Regulation of Gene Expression	1/3
CH 1010	Chemical Properties, Bonding, and Forces	1/3
CH 1020	Chemical Reactions	1/3
CH 1030	Kinetics, Equilibrium and Thermodynamics	1/3
CH 1040	Spectroscopy in Organic and Polymer Chemistry	1/3
CH 2310	Organic Chemistry I	1/3
CH 2320	Organic Chemistry II	1/3
CH 2330	Organic Chemistry III	1/3
CH 2360	Organic Laboratory	1/3
CH 2640	Experimental Chemistry I: Instrumental Analysis	1/3
CH 2650	Modern Physical Chemistry Methods	1/3
CH 2660	Organic Synthesis and Analysis Laboratory	1/3
CH 2670	Investigation of Coordination Complexes Through Inquiry	1/3
CH 3310	Advanced Organic Chemistry	1/3
CH 3410	Structure, Bonding, and Reactivity in Inorganic Chemistry	1/3
CH 3510	Chemical Thermodynamics	1/3
CH 3530	Quantum Chemistry	1/3
CH 3550	Chemical Dynamics	1/3
CH 4110	Protein Structure and Function	1/3
CH 4120	Lipids and Biomembrane Functions	1/3
CH 4130	Nucleic Acids and Bioinformation	1/3
CH 4140	Metabolism and Disease	1/3
CH 4150	Enzymology and Protein Characterization Laboratory	1/3
CH 4160	Membrane Biophysics	1/3
CH 4330	Organic Synthesis	1/3
CH 4420	Principles and Applications of Group Theory in Chemistry	1/3
CH 4520	Chemical Statistical Mechanics	1/3

Chemical Engineering (CHE) Courses

Item #	Title	Units
CE 4063/CHE 4063	Transport & Transformations in the Environment	1/3
CHE 1011	Introduction to Chemical Engineering	1/3
CHE 2011	Chemical Engineering Fundamentals	1/3
CHE 2012	Elementary Chemical Processes	1/3
CHE 2013	Applied Chemical Engineering Thermodynamics	1/3
CHE 2014	Advanced Chemical Processes	1/3
CHE 3201	Kinetics and Reactor Design	1/3
CHE 3301	Introduction to Biological Engineering	1/3
CHE 3501	Applied Mathematics in Chemical Engineering	1/3
CHE 3702	Energy Challenges in the 21st Century	1/3
CHE 3722	Bioenergy	1/3
CHE 4401	Unit Operations of Chemical Engineering I	1/3
CHE 4402	Unit Operations of Chemical Engineering II	1/3
CHE 4403	Chemical Engineering Design	1/3
CHE 4404	Chemical Plant Design Project	1/3
CHE 4405	Chemical Process Dynamics and Control Laboratory	1/3
CHE 4410	Chemical Process Safety Design	1/3

Electrical and Computer Engineering (ECE) Courses

Item #	Title	Units
BME 4011/ECE 4011	Biomedical Signal Analysis	1/3
BME 4023/ECE 4023	Biomedical Instrumentation Design	1/3
CS 4801/ECE 4802	Introduction to Cryptography and Communication Security	1/3
ECE 1799	Frontiers and Current Issues of Electrical and Computer Engineering	1/6
ECE 2010	Introduction to Electrical and Computer Engineering	1/3
ECE 2019	Sensors, Circuits, and Systems	1/3
ECE 2029	Introduction to Digital Circuit Design	1/3
ECE 2049	Embedded Computing in Engineering Design	1/3
ECE 2112	Electromagnetic Fields	1/3
ECE 2201	Microelectronic Circuits I	1/3
ECE 2305	Introduction to Communications and Networks	1/3
ECE 2311	Continuous-Time Signal and System Analysis	1/3
ECE 2312	Discrete-Time Signal and System Analysis	1/3
ECE 2799	Electrical and Computer Engineering Design	1/3
ECE 3012	Introduction to Control Systems Engineering	1/3
ECE 3113	Introduction to RF Circuit Design	1/3
ECE 3204	Microelectronic Circuits II	1/3
ECE 3308	Introduction to Wireless Networks	1/3
ECE 3311	Principles of Communication Systems	1/3
ECE 3500	Electric Power and Renewable Energy Systems	1/3
ECE 3501	Electromechanical Energy Systems	1/3
ECE 3829	Advanced Digital System Design with FPGAs	1/3
ECE 3849	Real-Time Embedded Systems	1/3
ECE 4305	Software-Defined Radio Systems and Analysis	1/3
ECE 4503	Power Electronics And Power Management	1/3
ECE 4703	Real-Time Digital Signal Processing	1/3
ECE 4801	Computer Organization and Design	1/3
ECE 4902	Analog Integrated Circuit Design	1/3
ECE 4904	Semiconductor Devices	1/3

Engineering Science Interdisciplinary (ES) Courses

Item #	Title	Units
ES 1020	Introduction to Engineering	1/3
ES 1310	Introduction to Computer Aided Design	1/3
ES 1500	Fundamentals of Systems Thinking	1/3
ES 2001	Introduction to Materials Science	1/3
ES 2501	Introduction to Static Systems	1/3
ES 2502	Stress Analysis	1/3
ES 2503	Introduction to Dynamic Systems	1/3
ES 2800	Environmental Impacts of Engineering Decisions	1/3
ES 3001	Introduction to Thermodynamics	1/3
ES 3002	Mass Transfer	1/3
ES 3003	Heat Transfer	1/3
ES 3004	Fluid Mechanics	1/3
ES 3011	Control Engineering I	1/3
ES 3323	Advanced Computer Aided Design	1/3
ES 3501	A Project-Based Introduction to Systems Engineering	1/3

Geosciences (GE) Courses

Item #	Title	Units
GE 2341	Geology	1/3

Mechanical Engieering (ME) Courses

Item #	Title	Units
BME 4504/ME 4504	Biomechanics	1/3
BME 4606/ME 4606	Biofluids	1/3
BME 4814/ME 4814	Biomaterials	1/3
ME 1520	The Technology of Alpine SkIlng	1/3
ME 1800	Manufacturing Science, Prototyping, and Computer-Controlled Machining	1/3
ME 2300	Introduction to Engineering Design	1/3
ME 2312	Introduction to Computational Solutions for Engineering Problems	1/3
ME 2820	Materials Processing	1/3
ME 3310	Kinematics of Mechanisms	1/3
ME 3311	Dynamics of Mechanisms and Machines	1/3
ME 3320	Design of Machine Elements	1/3
ME 3411	Intermediate Fluid Mechanics	1/3
ME 3501	Elementary Continuum Mechanics	1/3
ME 3506	Rehabilitation Engineering	1/3
ME 3820	Computer-Aided Manufacturing	1/3
ME 3901	Engineering Experimentation	1/3
ME 3902	Project-Based Engineering Experimentation	1/3
ME 4320	Advanced Engineering Design	1/3
ME 4323	Fundamentals of Drivetrain Systems	1/3
ME 4324	Integrated Design of Mechanical Systems	1/3
ME 4422	Design and Optimization of Thermal Systems	1/3
ME 4424	Radiation Heat Transfer Application and Design	1/3
ME 4429	Thermofluid Application and Design	1/3
ME 4430	Integrated Thermomechanical Design and Analysis	1/3
ME 4505	Advanced Dynamics	1/3
ME 4506	Mechanical Vibrations	1/3
ME 4512	Introduction to the Finite Element Method	1/3
ME 4710	Gas Turbines for Propulsion and Power Generation	1/3
ME 4813	Ceramics and Glasses for Engineering Applications	1/3
ME 4821	Plastics	1/3
ME 4832	Corrosion and Corrosion Control	1/3
ME 4840	Physical Metallurgy	1/3
ME 4875/MTE 575	Introduction to Nanomaterials and Nanotechnology	1/3
RBE 4322/ME 4322	Modeling and Analysis of Mechatronic Systems	1/3

Physics (PH) Courses

Item #	Title	Units
PH 1110	General Physics—Mechanics	1/3
PH 1111	Principles of Physics—Mechanics	1/3
PH 1120	General Physics—Electricity and Magnetism	1/3
PH 1121	Principles of Physics—Electricity and Magnetism	1/3
PH 1130	Modern Physics	1/3
PH 1140	Oscillations and Waves	1/3
PH 1150	Introductory Physics of Living Systems	1/3
PH 2101	Principles of Thermodynamics	1/3
PH 2201	Intermediate Mechanics I	1/3
PH 2202	Intermediate Mechanics II	1/3
PH 2301	Electromagnetic Fields	1/3
PH 2501	Photonics	1/3
PH 2502	Lasers	1/3
PH 2510	Atomic Force Microscopy	1/3
PH 2520	Introduction to Astrophysics	1/3
PH 2540	Solar Systems	1/3
PH 2550/AE 2550	Atmospheric and Space Environments	1/3
PH 2601	Photonics Laboratory	1/3
PH 2651	Intermediate Physics Laboratory	1/3
PH 3206	Statistical Physics	1/3
PH 3301	Electromagnetic Theory	1/3
PH 3401	Quantum Mechanics I	1/3
PH 3402	Quantum Mechanics II	1/3
PH 3501	Relativity	1/3
PH 3502	Solid State Physics	1/3
PH 3503	Nuclear Physics	1/3
PH 3504	Optics	1/3
PH 4201/PH 511	Advanced Classical Mechanics	1/3

Robotics Engineering (RBE) Courses

Item #	Title	Units
RBE 1001	Introduction to Robotics	1/3
RBE 2001	Unified Robotics I: Actuation	1/3
RBE 2002	Unified Robotics II: Sensing	1/3
RBE 3001	Unified Robotics III: Manipulation	1/3
RBE 3002	Unified Robotics IV: Navigation	1/3
RBE 3100	Social Implications of Robotics	1/3
RBE 4322/ME 4322	Modeling and Analysis of Mechatronic Systems	1/3
RBE 4540	Vision-based Robotic Manipulation	1/3
RBE 4815	Industrial Robotics	1/3

Mathematics and Data Analysis Requirement (Minimum 2/3 Units)

Choose 2/3 units from:

Item #	Title	Units
IMGD 2905	Data Analysis for Game Development	1/3

Any course with a DS or MA Prefix

Item #	Title	Units
BCB 4004/MA 4603	Statistical Methods in Genetics and Bioinformatics	1/3
CS 2022/MA 2201	Discrete Mathematics	1/3
CS 4032/MA 3257	Numerical Methods for Linear and Nonlinear Systems	1/3
CS 4033/MA 3457	Numerical Methods for Calculus and Differential Equations	1/3
CS 4433/DS 4433	Big Data Management and Analytics	1/3
CS 4804	Data Visualization	1/3
DS 1010	Data Science I: Introduction to Data Science	1/3
DS 2010	Data Science II: Modeling and Data Analysis	1/3
DS 3010	Data Science III: Computational Data Intelligence	1/3
DS 4635/MA 4635	Data Analytics and Statistical Learning	1/3
MA 1020	Calculus I with Preliminary Topics	1/3
MA 1021	Calculus I	1/3
MA 1022	Calculus II	1/3
MA 1023	Calculus III	1/3
MA 1024	Calculus IV	1/3
MA 1033	Theoretical Calculus III	1/3
MA 1034	Theoretical Calculus IV	1/3
MA 1120	Calculus II (Semester Version)	1/3
MA 1801	Denksport	1/12
MA 1971	Bridge to Higher Mathematics	1/3
MA 2051	Ordinary Differential Equations	1/3
MA 2071	Matrices and Linear Algebra I	1/3
MA 2072	Accelerated Matrices and Linear Algebra I	1/3
MA 2073	Matrices and Linear Algebra II	1/3
MA 2210	Mathematical Methods in Decision Making	1/3
MA 2211	Theory of Interest I	1/3
MA 2212	Theory of Interest II	1/3
MA 2251	Vector and Tensor Calculus	1/3
MA 2271	Graph Theory	1/3
MA 2273	Combinatorics	1/3
MA 2431	Mathematical Modeling with Ordinary Differential Equations	1/3
MA 2610	Applied Statistics for the Life Sciences	1/3
MA 2611	Applied Statistics I	1/3
MA 2612	Applied Statistics II	1/3
MA 2621	Probability for Applications	1/3
MA 2631	Probability Theory	1/3
MA 3212	Actuarial Mathematics I	1/3
MA 3213	Actuarial Mathematics II	1/3
MA 3231	Linear Programming	1/3
MA 3233	Discrete Optimization	1/3
MA 3457/CS 4033	Numerical Methods for Calculus and Differential Equations	1/3
MA 3471	Advanced Ordinary Differential Equations	1/3
MA 3475	Calculus of Variations	1/3
MA 3627	Introduction to the Design and Analysis of Experiments	1/3
MA 3631	Mathematical Statistics	1/3
MA 3823	Group Theory	1/3
MA 3825	Rings and Fields	1/3
MA 3831	Principles of Real Analysis I	1/3
MA 3832	Principles of Real Analysis II	1/3
MA 4213	Loss Models I - Risk Theory	1/3
MA 4214	Loss Models II - Survival Models	1/3
MA 4216	Actuarial Seminar	
MA 4222	Top Algorithms in Applied Mathematics	1/3

MA 4235	Mathematical Optimization	1/3
MA 4237	Probabilistic Methods in Operations Research	1/3
MA 4291	Applied Complex Variables	1/3
MA 4411	Numerical Analysis of Differential Equations	1/3
MA 4451	Boundary Value Problems	1/3
MA 4473	Partial Differential Equations	1/3
MA 4631	Probability and Mathematical Statistics I	1/3
MA 4632	Probability and Mathematical Statistics II	1/3
MA 4891	Topics in Mathematics	1/3
MA 4892	Topics in Actuarial Mathematics	1/3
MA 4895	Differential Geometry	1/3

General IMGD Requirement (Minimum 5/3 Units)

Choose 5/3 units from any courses with an IMGD prefix, which must include:

Any 1000+ IMGD course (Minimum 1/3 Units)

Item #	Title	Units
AR 2048/IMGD 2048	Technical Art and Character Rigging	1/3
AR 2101/IMGD 2101	3D Modeling I	1/3
AR 2222/IMGD 2222	2D Animation I	1/3
AR 2333/IMGD 2333	3D Animation I	1/3
AR 2700/IMGD 2700	Digital Painting	1/3
AR 2740/IMGD 2740	3D Environmental Modeling	1/3
AR 3101/IMGD 3101	3D Modeling II	1/3
AR 3200/IMGD 3200	Interactive Electronic Arts	1/3
AR 3210/IMGD 3210	Human Figure in Motion	1/3
AR 3222/IMGD 3222	2D Animation II	1/3
AR 3333/IMGD 3333	3D Animation II	1/3
AR 3700/IMGD 3700	Concept Art and Creative Illustration	1/3
CS 4100/IMGD 4100	Artificial Intelligence for Interactive Media and Games	1/3
CS 4300/IMGD 4300	Graphics, Simulation, and Aesthetics	1/3
IMGD 1000	Critical Studies of Interactive Media and Games	1/3
IMGD 1001	The Game Development Process	1/3
IMGD 1002	Storytelling in Interactive Media and Games	1/3
IMGD 2000	Social Issues in Interactive Media and Games	1/3
IMGD 2001	Philosophy and Ethics of Computer Games	1/3
IMGD 2030	Game Audio I	1/3
IMGD 2450/WR 2450	Narrative Design for Interactive Media and Games	1/3
IMGD 2500	Design of Tabletop Strategy Games	1/3
IMGD 2900	Digital Game Design I	1/3
IMGD 2905	Data Analysis for Game Development	1/3
IMGD 3000	Technical Game Development I	1/3
IMGD 3030	Game Audio II	1/3
IMGD 3100	Novel Interfaces for Interactive Environments	1/3
IMGD 3450/WR 3450	Writing Characters for Interactive Media & Games	1/3
IMGD 3500	Artistic Game Development I	1/3
IMGD 3900	Digital Game Design II	1/3
IMGD 4000	Technical Game Development II	1/3
IMGD 4030	Advanced Topics in Interactive Audio	1/3
IMGD 4099	Special Topics in IMGD	1/6
IMGD 4200	History and Future of Immersive and Interactive Media	1/3
IMGD 4403	Motion Capture Techniques	1/3
IMGD 4500	Artistic Game Development II	1/3
IMGD 4600	Serious Games	1/3
IMGD 4700	Advanced Storytelling: Quest Logic and Level Design	1/3
IMGD 4900	Digital Game Design Studio	1/3

IMGD 3100 or IMGD/CS 4100 (1/3 Units)

Item #	Title	Units
IMGD 3100	Novel Interfaces for Interactive Environments	1/3

IMGD 3000 and IMGD 4000 (2/3 Units)

Item #	Title	Units
IMGD 3000	Technical Game Development I	1/3
IMGD 4000	Technical Game Development II	1/3

Any 4000+ IMGD course (1/3 Units)

Item #	Title	Units
CS 4100/IMGD 4100	Artificial Intelligence for Interactive Media and Games	1/3
CS 4300/IMGD 4300	Graphics, Simulation, and Aesthetics	1/3
IMGD 4000	Technical Game Development II	1/3
IMGD 4030	Advanced Topics in Interactive Audio	1/3
IMGD 4099	Special Topics in IMGD	1/6
IMGD 4200	History and Future of Immersive and Interactive Media	1/3
IMGD 4403	Motion Capture Techniques	1/3
IMGD 4500	Artistic Game Development II	1/3
IMGD 4600	Serious Games	1/3
IMGD 4700	Advanced Storytelling: Quest Logic and Level Design	1/3
IMGD 4900	Digital Game Design Studio	1/3

Computer Science Requirement (Minimum 11/3 Units)

Choose 11/3 units from any courses with a CS prefix, which must include:

5/3 Units of Any CS Courses

Item #	Title	Units
BCB 4002/CS 4802	Biovisualization	1/3
BCB 4003/CS 4803	Biological and Biomedical Database Mining	1/3
CS 1101	Introduction to Program Design	1/3
CS 1102	Accelerated Introduction to Program Design	1/3
CS 2011	Introduction to Machine Organization and Assembly Language	1/3
CS 2022/MA 2201	Discrete Mathematics	1/3
CS 2102	Object-Oriented Design Concepts	1/3
CS 2103	Accelerated Object-Oriented Design Concepts	1/3
CS 2119	Application Building with Object-Oriented Concepts	1/3
CS 2223	Algorithms	1/3
CS 2301	Systems Programming for Non-Majors	1/3
CS 2303	Systems Programming Concepts	1/3
CS 3013	Operating Systems	1/3
CS 3041	Human-Computer Interaction	1/3
CS 3133	Foundations of Computer Science	1/3
CS 3431	Database Systems I	1/3
CS 3516	Computer Networks	1/3
CS 3733	Software Engineering	1/3
CS 4032/MA 3257	Numerical Methods for Linear and Nonlinear Systems	1/3
CS 4033/MA 3457	Numerical Methods for Calculus and Differential Equations	1/3
CS 4099	Special Topics in Computer Science	1/3
CS 4100/IMGD 4100	Artificial Intelligence for Interactive Media and Games	1/3
CS 4120	Analysis of Algorithms	1/3
CS 4123	Theory of Computation	1/3
CS 4233	Object-Oriented Analysis and Design	1/3
CS 4241	Webware: Computational Technology for Network Information Systems	1/3
CS 4300/IMGD 4300	Graphics, Simulation, and Aesthetics	1/3
CS 4341	Introduction to Artificial Intelligence	1/3
CS 4342	Machine Learning	1/3
CS 4401	Software Security Engineering	1/3
CS 4404	Tools and Techniques in Computer Network Security	1/3
CS 4432	Database Systems II	1/3
CS 4433/DS 4433	Big Data Management and Analytics	1/3
CS 4445	Data Mining and Knowledge Discovery in Databases	1/3
CS 4513	Distributed Computing Systems	1/3
CS 4515	Computer Architecture	1/3
CS 4516	Advanced Computer Networks	1/3
CS 4518	Mobile and Ubiquitous Computing	1/3
CS 4533	Techniques of Programming Language Translation	1/3
CS 4536	Programming Languages	1/3
CS 4731	Computer Graphics	1/3
CS 4732	Computer Animation	1/3
CS 4801/ECE 4802	Introduction to Cryptography and Communication Security	1/3
CS 4804	Data Visualization	1/3
MA 3457/CS 4033	Numerical Methods for Calculus and Differential Equations	1/3

3/3 Units from the options below:

Item #	Title	Units
CS 3013	Operating Systems	1/3
CS 3041	Human-Computer Interaction	1/3
CS 3431	Database Systems I	1/3
CS 3516	Computer Networks	1/3
CS 3733	Software Engineering	1/3

3/3 Units from the options below:

Item #	Title	Units
CS 4233	Object-Oriented Analysis and Design	1/3
CS 4241	Webware: Computational Technology for Network Information Systems	1/3
CS 4341	Introduction to Artificial Intelligence	1/3
CS 4342	Machine Learning	1/3
CS 4445	Data Mining and Knowledge Discovery in Databases	1/3
CS 4518	Mobile and Ubiquitous Computing	1/3
CS 4731	Computer Graphics	1/3
CS 4732	Computer Animation	1/3

Computer Science Notes:

- Only CS 1004, CS 1101, CS 1102 and CS courses at the 2000-level or higher can be counted towards the Computer Science requirements.
- Only one of CS 1004, CS 1101 and CS 1102 may count towards the Computer Science requirement.
- Only one of CS 2301 and CS 2303 may count towards the Computer Science requirements.
- Only one of CS 2119 and CS 2102 may count towards the Computer Science requirement.
- CS 3043 cannot be chosen to satisfy the Computer Science course requirements.
- Any AP credits earned in Computer Science cannot be applied to the 30/3 unit distribution requirements of the IMGD BS degree. CS AP credit **can** be applied to the Unrestricted Electives units available outside the degree-specific distribution.

Major Qualifying Project Requirement

Interactive Media & Game Development Minor

Degree Type
Minor

The Interactive Media & Game Development Minor is for students who, for personal or career purposes, wish to earn official recognition of their achievements in IMGD, but do not have academic time to fulfill the requirements for the major.

General WPI rules that apply to the Minor are that at most three courses can be double-counted for any other degree requirement, and the capstone course cannot be a double-counted course.

Students interested in pursuing the Minor should speak with an IMGD advisor about the rules of pursuing the Minor, as well as finding a capstone course and any related background courses.

NOTE: IMGD Technical majors may not earn a minor in IMGD.

A total of six IMGD courses are required for the Minor degree requirement. This consists of:

Program Distribution Requirements for the IMGD Minor

Core IMGD (Minimum 2/3 Units)

Select two core IMGD units from this list:

Item #	Title	Units
IMGD 1000	Critical Studies of Interactive Media and Games	1/3
IMGD 1001	The Game Development Process	1/3
IMGD 1002	Storytelling in Interactive Media and Games	1/3

Additional IMGD (Minimum 3/3 Units)

Students must complete three additional IMGD courses. If necessary for the academic goals of a student's minor program, and with prior approval of the IMGD Minor Coordinator, may include one course in art history, visual art, creative writing and rhetoric, theatre, or music.

1000 Level Interactive Media and Game Development Courses

Item #	Title	Units
IMGD 1000	Critical Studies of Interactive Media and Games	1/3
IMGD 1001	The Game Development Process	1/3
IMGD 1002	Storytelling in Interactive Media and Games	1/3

2000 Level Interactive Media and Game Development Courses

Item #	Title	Units
AR 2048/IMGD 2048	Technical Art and Character Rigging	1/3
AR 2101/IMGD 2101	3D Modeling I	1/3
AR 2222/IMGD 2222	2D Animation I	1/3
AR 2333/IMGD 2333	3D Animation I	1/3
AR 2700/IMGD 2700	Digital Painting	1/3
AR 2740/IMGD 2740	3D Environmental Modeling	1/3
IMGD 2000	Social Issues in Interactive Media and Games	1/3
IMGD 2001	Philosophy and Ethics of Computer Games	1/3
IMGD 2030	Game Audio I	1/3
IMGD 2450/WR 2450	Narrative Design for Interactive Media and Games	1/3
IMGD 2500	Design of Tabletop Strategy Games	1/3
IMGD 2900	Digital Game Design I	1/3
IMGD 2905	Data Analysis for Game Development	1/3

3000 Level Interactive Media and Game Development Courses

Item #	Title	Units
AR 3101/IMGD 3101	3D Modeling II	1/3
AR 3200/IMGD 3200	Interactive Electronic Arts	1/3
AR 3210/IMGD 3210	Human Figure in Motion	1/3
AR 3222/IMGD 3222	2D Animation II	1/3
AR 3333/IMGD 3333	3D Animation II	1/3
AR 3700/IMGD 3700	Concept Art and Creative Illustration	1/3
IMGD 3000	Technical Game Development I	1/3
IMGD 3030	Game Audio II	1/3
IMGD 3100	Novel Interfaces for Interactive Environments	1/3
IMGD 3450/WR 3450	Writing Characters for Interactive Media & Games	1/3
IMGD 3500	Artistic Game Development I	1/3
IMGD 3900	Digital Game Design II	1/3

4000 Level Interactive Media and Game Development Courses

Item #	Title	Units
CS 4100/IMGD 4100	Artificial Intelligence for Interactive Media and Games	1/3
CS 4300/IMGD 4300	Graphics, Simulation, and Aesthetics	1/3
IMGD 4000	Technical Game Development II	1/3
IMGD 4030	Advanced Topics in Interactive Audio	1/3
IMGD 4099	Special Topics in IMGD	1/6
IMGD 4200	History and Future of Immersive and Interactive Media	1/3
IMGD 4403	Motion Capture Techniques	1/3
IMGD 4500	Artistic Game Development II	1/3
IMGD 4600	Serious Games	1/3
IMGD 4700	Advanced Storytelling: Quest Logic and Level Design	1/3
IMGD 4900	Digital Game Design Studio	1/3

Capstone Experience (Minimum 1/3 Units)

One 3000 or Higher level IMGD course as a final capstone.

3000 Level Interactive Media and Game Development Courses

Item #	Title	Units
AR 3101/IMGD 3101	3D Modeling II	1/3
AR 3200/IMGD 3200	Interactive Electronic Arts	1/3
AR 3210/IMGD 3210	Human Figure in Motion	1/3
AR 3222/IMGD 3222	2D Animation II	1/3
AR 3333/IMGD 3333	3D Animation II	1/3
AR 3700/IMGD 3700	Concept Art and Creative Illustration	1/3
IMGD 3000	Technical Game Development I	1/3
IMGD 3030	Game Audio II	1/3
IMGD 3100	Novel Interfaces for Interactive Environments	1/3
IMGD 3450/WR 3450	Writing Characters for Interactive Media & Games	1/3
IMGD 3500	Artistic Game Development I	1/3
IMGD 3900	Digital Game Design II	1/3

4000 Level Interactive Media and Game Development Courses

Item #	Title	Units
CS 4100/IMGD 4100	Artificial Intelligence for Interactive Media and Games	1/3
CS 4300/IMGD 4300	Graphics, Simulation, and Aesthetics	1/3
IMGD 4000	Technical Game Development II	1/3
IMGD 4030	Advanced Topics in Interactive Audio	1/3
IMGD 4099	Special Topics in IMGD	1/6
IMGD 4200	History and Future of Immersive and Interactive Media	1/3
IMGD 4403	Motion Capture Techniques	1/3
IMGD 4500	Artistic Game Development II	1/3
IMGD 4600	Serious Games	1/3
IMGD 4700	Advanced Storytelling: Quest Logic and Level Design	1/3
IMGD 4900	Digital Game Design Studio	1/3

Interactive Media & Game Development Major with Concentration in Audio & Music

Degree Type
Concentration

Concentrations are a formal degree designation (noted on a student's transcript), earned by completing a topic-specific selection of 6/3 units drawn from the IMGD Focus Pair and IMGD Electives.

In accordance with WPI policy, a student's contribution to their Major Qualifying Project (MQP) must incorporate substantial content/effort in their area of concentration.

Students taking the IMGD Audio & Music Concentration must satisfy the requirements below:

Program Distribution Requirements for the IMGD Audio & Video Concentration

IMGD Audio & Music Focus Pair (2/3 Units)

Satisfy the 2/3 units IMGD Focus Pair requirement by choosing the following courses:

Item #	Title	Units
IMGD 3030	Game Audio II	1/3
IMGD 4030	Advanced Topics in Interactive Audio	1/3

IMGD Electives Audio & Music Focus (Minimum 4/3 Units)

Satisfy 1/3 units IMGD Electives requirement by choosing from the following:

Item #	Title	Units
MU 2300	Foundations of Music Technology	1/3
MU 2501/PSY 2501	Music and Mind	1/3
MU 2611	Fundamentals of Music II	1/3
MU 2631	Glee Club	1/3
MU 2632	Alden Voices	1/3
MU 2633	Brass Ensemble	1/3
MU 2636	Concert Band	1/3
MU 2637	Orchestra	1/3
MU 2638	Chamber Choir	1/3
MU 2643	Jazz Ensemble	1/3
MU 2644	Stage Band	1/3
MU 2723	Music Composition	1/3
MU 2801	Making Music with Machines	1/3
MU 3730	Jazz Theory	1/3

Note: Other 3000+ level theory or practice courses may be used to satisfy this requirement, subject to program approval.

Satisfy 1/3 units IMGD Electives requirement by choosing from the following:

Item #	Title	Units
MU 2719	Jazz History	1/3
MU 2720	Music History I: Medieval Through the Baroque	1/3
MU 2721	Music History II: Classical to the Present	1/3
MU 2722	History of American Popular Music	1/3
MU 3001	World Music	1/3

Note: Other 3000+ level music history courses may be used to satisfy this requirement, subject to program approval.

Satisfy 2/3 units IMGD Electives requirement by choosing from the following:

Item #	Title	Units
MU 3002	Arranging and Orchestration	1/3
MU 3614	Topics in Midi	1/3
MU 3615	Topics in Digital Sound	1/3
MU 3616	Topics in Interactive Programming	1/3
MU 3620	Electronic Music Composition	1/3

Note: Other 3000+ level production courses may be used to satisfy this requirement, subject to program approval.

Major Qualifying Project (Minimum 3/3 Units)

Students pursuing the Audio & Music Concentration must contribute substantially to the audio & music aspects of their Major Qualifying Project.

Interactive Media & Game Development Major with Concentration in Design

Degree Type

Concentration

Concentrations are a formal degree designation (noted on a student's transcript), earned by completing a topic-specific selection of 6/3 units drawn from the IMGD Focus Pair and IMGD Electives.

In accordance with WPI policy, a student's contribution to their Major Qualifying Project (MQP) must incorporate substantial content/effort in their area of concentration.

Students taking the IMGD Design Concentration must satisfy the requirements below:

Program Distribution Requirements for the IMGD Design Concentration

IMGD Design Focus Pair (2/3 Units)

Students can satisfy the 2/3 units IMGD Focus Pair requirement by choosing Digital Game Design II (IMGD 3900) or Digital Game Design Studio (IMGD 4900).

Item #	Title	Units
IMGD 3900	Digital Game Design II	1/3
IMGD 4900	Digital Game Design Studio	1/3

IMGD Electives Design Focus (Minimum 4/3 Units)

Satisfy 2/3 units of the IMGD Electives requirement by choosing from any of the following:

Item #	Title	Units
EN 2219	Creative Writing	1/3
EN 3219	Advanced Creative Writing	1/3
IMGD 3450/WR 3450	Writing Characters for Interactive Media & Games	1/3
WR 2210	Business Writing and Communication	1/3
WR 2310	Visual Rhetoric	1/3
WR 3112	Rhetorical Theory	1/3
WR 3210	Technical Writing	1/3

Note: Other IMGD-related writing courses may be used to satisfy this requirement, subject to program approval.

Satisfy 2/3 units of the IMGD Electives requirement by choosing from any of the following:

Item #	Title	Units
IMGD 4200	History and Future of Immersive and Interactive Media	1/3
IMGD 4600	Serious Games	1/3
IMGD 4700	Advanced Storytelling: Quest Logic and Level Design	1/3
IMGD 5000	Game Design Studio	1/3
IMGD 5200	History and Future of Immersive and Interactive Media	1/3
IMGD 5300	Design of Interactive Experiences	1/3
MIS 4741	User Experience and Design	1/3

Notes: Students may take IMGD 4200 OR IMGD 5200 to satisfy this requirement, but not both. Students may take MIS 4741 OR MIS 583 to satisfy this requirement, but not both. Other 3000+ level IMGD-related design courses may be taken to satisfy this requirement, subject to program approval.

Major Qualifying Project (Minimum 3/3 Units)

Students pursuing the Design Concentration must contribute substantially to the design aspects of their Major Qualifying Project.

Interactive Media & Game Development Major with Concentration in Technical Art

Degree Type

Concentration

Concentrations are a formal degree designation (noted on a student's transcript), earned by completing a topic-specific selection of 6/3 units drawn from the IMGD Focus Pair and IMGD Electives.

In accordance with WPI policy, a student's contribution to their Major Qualifying Project (MQP) must incorporate substantial content/effort in their area of concentration.

Students taking the IMGD Technical Art Concentration must satisfy the requirements below:

Program Distribution Requirements for the IMGD Technical Art Concentration

IMGD Technical Art Focus Pair (Minimum 2/3 Units)

Satisfy the 2/3 units IMGD Focus Pair requirement by choosing the following courses:

Item #	Title	Units
IMGD 3000	Technical Game Development I	1/3
IMGD 4000	Technical Game Development II	1/3

IMGD Electives Technical Art Focus

Satisfy the 4/3 units IMGD Electives requirement by choosing from the following:

Any course with a CS prefix (Minimum 1/3 Units)

Item #	Title	Units
BCB 4002/CS 4802	Biovisualization	1/3
BCB 4003/CS 4803	Biological and Biomedical Database Mining	1/3
CS 1004	Introduction to Programming for Non-Majors	1/3
CS 1101	Introduction to Program Design	1/3
CS 1102	Accelerated Introduction to Program Design	1/3
CS 2011	Introduction to Machine Organization and Assembly Language	1/3
CS 2022/MA 2201	Discrete Mathematics	1/3
CS 2102	Object-Oriented Design Concepts	1/3
CS 2103	Accelerated Object-Oriented Design Concepts	1/3
CS 2119	Application Building with Object-Oriented Concepts	1/3
CS 2223	Algorithms	1/3
CS 2301	Systems Programming for Non-Majors	1/3
CS 2303	Systems Programming Concepts	1/3
CS 3013	Operating Systems	1/3
CS 3041	Human-Computer Interaction	1/3
CS 3043	Social Implications of Information Processing	1/3
CS 3133	Foundations of Computer Science	1/3
CS 3431	Database Systems I	1/3
CS 3516	Computer Networks	1/3
CS 3733	Software Engineering	1/3
CS 4032/MA 3257	Numerical Methods for Linear and Nonlinear Systems	1/3
CS 4033/MA 3457	Numerical Methods for Calculus and Differential Equations	1/3
CS 4099	Special Topics in Computer Science	1/3
CS 4100/IMGD 4100	Artificial Intelligence for Interactive Media and Games	1/3
CS 4120	Analysis of Algorithms	1/3
CS 4123	Theory of Computation	1/3
CS 4233	Object-Oriented Analysis and Design	1/3
CS 4241	Webware: Computational Technology for Network Information Systems	1/3
CS 4300/IMGD 4300	Graphics, Simulation, and Aesthetics	1/3
CS 4341	Introduction to Artificial Intelligence	1/3
CS 4342	Machine Learning	1/3
CS 4401	Software Security Engineering	1/3
CS 4404	Tools and Techniques in Computer Network Security	1/3
CS 4432	Database Systems II	1/3
CS 4433/DS 4433	Big Data Management and Analytics	1/3
CS 4445	Data Mining and Knowledge Discovery in Databases	1/3
CS 4513	Distributed Computing Systems	1/3
CS 4515	Computer Architecture	1/3
CS 4516	Advanced Computer Networks	1/3
CS 4518	Mobile and Ubiquitous Computing	1/3
CS 4533	Techniques of Programming Language Translation	1/3
CS 4536	Programming Languages	1/3
CS 4731	Computer Graphics	1/3
CS 4732	Computer Animation	1/3
CS 4801/ECE 4802	Introduction to Cryptography and Communication Security	1/3
CS 4804	Data Visualization	1/3
MA 3457/CS 4033	Numerical Methods for Calculus and Differential Equations	1/3

3/3 units from the following courses (Minimum 3/3 Units):

Item #	Title	Units
AR 2048/IMGD 2048	Technical Art and Character Rigging	1/3
AR 3101/IMGD 3101	3D Modeling II	1/3
AR 3200/IMGD 3200	Interactive Electronic Arts	1/3
AR 3333/IMGD 3333	3D Animation II	1/3

Major Qualifying Project

Students pursuing the Technical Art Concentration must contribute substantially to the technical art aspects of their Major Qualifying Project.

Interactive Media & Game Development Major with Concentration in Visual Art

Degree Type

Concentration

Concentrations are a formal degree designation (noted on a student's transcript), earned by completing a topic-specific selection of 6/3 units drawn from the IMGD Focus Pair and IMGD Electives.

In accordance with WPI policy, a student's contribution to their Major Qualifying Project (MQP) must incorporate substantial content/effort in their area of concentration.

Students taking the IMGD Visual Arts Concentration must satisfy the requirements below:

Program Distribution Requirements for the IMGD Visual Arts Concentration

IMGD Visual Art Focus Pair (2/3 Units)

Students can satisfy the 2/3 units IMGD Focus Pair requirement by choosing Artistic Game Development I & II (IMGD 3500 + 4500)

Item #	Title	Units
IMGD 3500	Artistic Game Development I	1/3
IMGD 4500	Artistic Game Development II	1/3

IMGD Electives Visual Art Focus (Minimum 4/3 Units)

AR 1100 or AR 1101 or AR 2301 (Minimum 1/3 Units)

Item #	Title	Units
AR 1100	Essentials of Art	1/3
AR 1101	Digital Imaging and Computer Art	1/3
AR 2301	Graphic Design	1/3

AR 1111, AR 2111, AR 2114, AR 3112 or AR 3150 (Minimum 1/3 Units)

Item #	Title	Units
AR 1111	Introduction to Art History	1/3
AR 2111	Modern Art	1/3
AR 2114	Modern Architecture in the American Era, 1750-2001 and Beyond	1/3
AR 3112	Modernism, Mass Culture, and the Avant-Garde	1/3
AR 3150/ID 3150	Light, Vision and Understanding	1/3

IMGD/AR 3101, IMGD/AR 3200, IMGD/AR 3222, IMGD/AR 3333, or IMGD/AR 3700 (Minimum 2/3 Units)

Item #	Title	Units
AR 3101/IMGD 3101	3D Modeling II	1/3
AR 3200/IMGD 3200	Interactive Electronic Arts	1/3
AR 3222/IMGD 3222	2D Animation II	1/3
AR 3333/IMGD 3333	3D Animation II	1/3
AR 3700/IMGD 3700	Concept Art and Creative Illustration	1/3

Major Qualifying Project

Students pursuing the Visual Art Concentration must contribute substantially to the visual art aspects of their Major Qualifying Project.

Interactive Media & Game Development Major with Concentration in Writing

Degree Type
Concentration

Concentrations are a formal degree designation (noted on a student's transcript), earned by completing a topic-specific selection of 6/3 units drawn from the IMGD Focus Pair and IMGD Electives.

In accordance with WPI policy, a student's contribution to their Major Qualifying Project (MQP) must incorporate substantial content/effort in their area of concentration.

Students taking the IMGD Writing Concentration must satisfy the requirements below:

Program Distribution Requirements for the IMGD Writing Concentration

IMGD Writing Focus Pair (2/3 Units)

Satisfy the 2/3 units IMGD Focus Pair requirement by choosing the following courses:

Item #	Title	Units
IMGD 2450/WR 2450	Narrative Design for Interactive Media and Games	1/3
IMGD 4700	Advanced Storytelling: Quest Logic and Level Design	1/3

IMGD Electives Writing Focus (Minimum 4/3 Units)

Satisfy the 4/3 units IMGD Electives requirement by choosing from the following:

Item #	Title	Units
IMGD 3450/WR 3450	Writing Characters for Interactive Media & Games	1/3

3/3 units (including at least 2/3 units at 3000+ level) from the following:

Item #	Title	Units
EN 2219	Creative Writing	1/3
EN 3219	Advanced Creative Writing	1/3
WR 2010	Elements of Style	1/3
WR 2210	Business Writing and Communication	1/3
WR 2310	Visual Rhetoric	1/3
WR 3112	Rhetorical Theory	1/3
WR 3210	Technical Writing	1/3

Note: Other IMGD-related writing courses may be used to satisfy this requirement, subject to program approval.

Major Qualifying Project (Minimum 3/3 Units)

Students pursuing the Technical Art Concentration must contribute substantially to the technical art aspects of their Major Qualifying Project.

International and Global Studies

DIRECTOR: P. H. HANSEN

ASSOCIATED FACULTY: W.A.B. Addison (HU), M. Belz (IGSD), E. Boucher-Yip (HU), M. Brahimi (HU), U. Brisson (HU), C. Brown (SSPS), F. Carrera (IGSD), C. Dehner (IGSD), D. DiMassa (HU), H. Droessler (HU), W. Du (HU), L. Elgert (SSPS), M. Elmes (BUS), P. Everett (HU), K. Foo (IGSD), J. Galante (HU), D. Golding (IGSD), P. H. Hansen (HU), R. Hersh (IGSD), S. Jiusto (IGSD), R. Krueger (SSPS), C. Kurlanska (IGSD), S. McCauley (IGSD), A. S. Madan (HU), I. Matos-Nin (HU), R. Moody, (HU), S. Nikitina (HU), O. Pavlov (SSPS), C. Peet (IGSD), G. Pfeifer (HU), M. J. Radzicki (SSPS), K. J. Rissmiller (SSPS), A. Rivera (HU), J. Rudolph (HU),
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International and Global Studies prepares men and women for future leadership roles in business, industry, research, government and public affairs. International and Global Studies integrates WPI's international and global courses in the humanities, social sciences and business with its global projects and exchange programs. International and Global Studies courses on-campus prepare students to go abroad. After an experience overseas, students integrate their experiences and explore their career options in a capstone seminar. International and Global Studies at WPI offers a range of options including a minor, major, or double major.

International and Global Studies Major

Degree Type

Bachelor of Science

Distribution Requirements for the International and Global Studies Major:

International and Global Core (3/3 Units)

Only courses with the prefix INTL count toward this requirement. Must include the senior seminar in international and global studies.

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Item #	Title	Units
INTL 1100	Introduction to International and Global Studies	1/3
INTL 1200	Introduction to Asia	1/3
INTL 1300	Introduction to Latin America	1/3
INTL 2100	Approaches to Global Studies	1/3
INTL 2110	Global Justice	1/3
INTL 2210	Popular Culture and Social Change in Asia	1/3
INTL 2310	Modern Latin America	1/3
INTL 2320	Environmental Justice in the Global Caribbean and Latin America	1/3
INTL 2410	Modern Africa	1/3
INTL 2420	Middle East, North Africa and Mediterranean	1/3
INTL 2510	Contemporary Europe: Union and Disunion	1/3
INTL 2520	Russia Ready: Language and Cultural Context	1/6
INTL 2910	Topics in Global Studies	1/3
INTL 3050	Global Re-Entry Seminar	1/6
INTL 4100	Senior Seminar in International and Global Studies	1/3

International and Global Fields (12/3 Units)

Majors complete at least one unit of work in each of the following areas. They must also complete at least one additional unit of work in one of these areas, which will be considered their primary field.

History and International and Global Studies

These include any course with the INTL prefix and/or any international and global history course (see list).

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Item #	Title	Units
INTL 1100	Introduction to International and Global Studies	1/3
INTL 1200	Introduction to Asia	1/3
INTL 1300	Introduction to Latin America	1/3
INTL 2100	Approaches to Global Studies	1/3
INTL 2110	Global Justice	1/3
INTL 2210	Popular Culture and Social Change in Asia	1/3
INTL 2310	Modern Latin America	1/3
INTL 2320	Environmental Justice in the Global Caribbean and Latin America	1/3
INTL 2410	Modern Africa	1/3
INTL 2420	Middle East, North Africa and Mediterranean	1/3
INTL 2510	Contemporary Europe: Union and Disunion	1/3
INTL 2520	Russia Ready: Language and Cultural Context	1/6
INTL 2910	Topics in Global Studies	1/3
INTL 3050	Global Re-Entry Seminar	1/6

Language, Literature, and Culture

These include any course in foreign languages, civilization, and literature offered at WPI (e.g. AB, CN, GN, SP), or in the Consortium with the prior approval of the Program Review Committee; also courses approved by the Program Review Committee in Art History (e.g. AR 1111, AR 3112), English Literature (e.g. EN 2251, EN 3222), Music History (e.g. MU 3001), Philosophy (e.g. PY 2716), Religion (e.g. RE 2724), or Writing. Majors who designate Language, Literature, and Culture as their primary field should take most of their courses in a single discipline or in a coherent program approved by the Program Review Committee.

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Item #	Title	Units
AB 1531	Elementary Arabic I	1/3
AB 1532	Elementary Arabic II	1/3
AB 1533	Elementary Arabic III	1/3
AB 2531	Intermediate Arabic I	1/3
AB 2532	Intermediate Arabic II	1/3
AB 2533	Intermediate Arabic III	1/3
CN 1541	Elementary Chinese I	1/3
CN 1542	Elementary Chinese II	1/3
CN 1543	Elementary Chinese III	1/3
CN 2541	Intermediate Chinese I	1/3
CN 2542	Intermediate Chinese II	1/3
CN 2543	Intermediate Chinese III	1/3
CN 2544	Intermediate Chinese IV	1/3
CN 3541	Advanced Chinese I	1/3
CN 3542	Advanced Chinese II	1/3
CN 3543	Advanced Chinese III	1/3
CN 3561	Business Chinese	1/3
GN 1511	Elementary German I: Identities and Communities	1/3
GN 1512	Elementary German II: Navigating Everyday Life in German-speaking Contexts	1/3
GN 2511	Intermediate German I: Cultural Practices and Products of the German-Speaking World	1/3
GN 2512	Intermediate German II: Pasts, Presents, and Futures of the German-Speaking World	1/3
GN 3511	Advanced German I: Exploration and Innovation in the German-Speaking World	1/3
GN 3512	Advanced German II: National Identities and Stories	1/3
GN 3513	Survey of German Civilization and Culture from 1871 to the Present	1/3
GN 3514	Seminar on Selected Topics in German Literature	1/3
GN 3516	German Film	1/3
ID 3525/SP 3525	Spanish American Film/Media: Cultural Issues	1/3
ID 3526/SP 3526	Comparative Business Environments	1/3
ID 3527/SP 3527	Technical and Business Spanish	1/3
ID 3529/SP 3529	Caribbeanness: Voices of the Spanish Caribbean	1/3
ID 3530/SP 3530	Spanish Film/Media: Cultural Issues	1/3
ID 3531/SP 3531	Contemporary Us Latino Literature & Culture	1/3
SP 1523	Elementary Spanish I	1/3
SP 1524	Elementary Spanish II	1/3
SP 2521	Intermediate Spanish I	1/3
SP 2522	Intermediate Spanish II	1/3
SP 3521	Advanced Spanish I	1/3
SP 3522	Advanced Spanish II	1/3
SP 3523	Topics in Latin American Culture	1/3
SP 3524	Spanish-American Literature in the Twentieth Century	1/3
SP 3528	Spanish Culture and Civilization	1/3
SP 3532	Studies in Spanish Literature: Artistic Expression and Nation Building	1/3
SP 3533	Ecocrítica: Environmental Cultural Production in Latin America	1/3
SP 3534	Intersections of Science, Engineering, Art, Literature, and Film in Latin America and the Caribbean	1/3

Social Sciences and Business

These include international and global social sciences courses (see list), international and global courses in business (e.g. BUS 1020), and 1/3 unit of a first-year course (e.g. FY 1100). Students may count courses taken for the two-course requirement in Social Sciences.

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Item #	Title	Units
BUS 1020	Global Environment of Business Decisions	1/3
BUS 2001	WPI Means Business	1/3
BUS 2020	The Legal Environment of Business Decisions	1/3
BUS 2080	Data Analysis for Decision Making	1/3
FY 1100 & FY 1101	The Great Problems Seminars	1/3
FY 1800	Discovering Majors and Careers	1/12
INTL 1100	Introduction to International and Global Studies	1/3
INTL 1200	Introduction to Asia	1/3
INTL 1300	Introduction to Latin America	1/3
INTL 2100	Approaches to Global Studies	1/3
INTL 2110	Global Justice	1/3
INTL 2210	Popular Culture and Social Change in Asia	1/3
INTL 2310	Modern Latin America	1/3
INTL 2320	Environmental Justice in the Global Caribbean and Latin America	1/3
INTL 2410	Modern Africa	1/3
INTL 2420	Middle East, North Africa and Mediterranean	1/3
INTL 2510	Contemporary Europe: Union and Disunion	1/3
INTL 2520	Russia Ready: Language and Cultural Context	1/6
INTL 2910	Topics in Global Studies	1/3
INTL 3050	Global Re-Entry Seminar	1/6
INTL 4100	Senior Seminar in International and Global Studies	1/3
MIS 2300	Business Applications of Blockchain	1/3
OBC 1010	Leadership Practice	1/3

International and Global Experience (0/3 Units)

International Studies majors are required to have a study-abroad experience. (In very unusual cases exceptions may be made to this requirement but only with prior approval of the Director and Program Review Committee). This abroad experience may take the form of a project, exchange, or internship approved by the Program Review Committee. The study-abroad experience should be educational in nature and equivalent in length to at least one WPI term.

Science, Technology, Engineering, Mathematics (6/3 Units)

Must include a minimum of 2/3 units in mathematics or computer science and 2/3 units in natural science or engineering science. The remaining 2/3 units may be from any area of mathematics, computer science, natural science or engineering science. Double majors may count courses taken for their other major.

Electives (6/3 Units)

Electives may be from any area except Air Force Aerospace Studies, Military Science or Wellness and Physical Education. Double-majors may count courses taken for their other major.

MQP (3/3 Units)

Double Major in International and Global Studies

Students may pursue a double major in International and Global Studies and any area of study at WPI except a major in Humanities and Arts. To pursue the double major, a student must satisfy all of the degree requirements for both disciplines, including an MQP and Distribution Requirements. The double major in International and Global Studies requires the same distribution of courses as the major and either a second MQP in International and Global Studies or an interdisciplinary MQP that satisfies the requirement of both programs. Double majors are also required to have an International and Global Experience.

International and Global Experiences

An International and Global Experience may take the form of an international and global IQP, MQP, Humanities and Arts Inquiry Seminar, internship or exchange program. Students often plan their international and global experience in their Sophomore year. All students are advised to consult the list of projects offered at WPI's Global Project Centers. Each fall, the projects and exchange programs for the following year are widely advertised on campus. For information about student exchange programs, see page 227.

Award-winning projects at WPI are frequently on international topics. International and Global Studies offers the opportunity not only to complete some of the highest quality projects at WPI, but also to offer solutions to some of the most challenging problems in the world.

Students interested in International and Global Studies may ask any member of the Associated Faculty for more information, or they may consult our webpages https://www.wpi.edu/academics/departments/international-global-studies.

International and Global Studies Minor

Degree Type
Minor

The minor in International and Global Studies offers students the opportunity to integrate coursework on campus with a global educational experience. Students interested in the minor should meet with faculty associated with International and Global Studies as early as possible. They will be assigned an advisor after completing a minor declaration form.

WPI policy requires that no more than one unit of course work can be double counted toward other degree requirements. Thus, students may count three courses for the minor taken to fulfill other degree requirements (such as the Humanities and Arts Requirement or two course requirement in the Social Sciences) as long as one unit of the minor does not double-count. In other words, students must take INTL 4100 and two other courses for this minor that do not count for another degree requirement.

The International and Global Studies minor consists of two units of work distributed in the following way:

Program Distribution Requirements for the International and Global Studies Minor

International and Global Core (Minimum 2/3 Units)

Any courses with the INTL prefix or courses selected from international and global history or social science courses.

International and Global Electives (Minimum 3/3 Units)

These may be selected from among international and global courses in the humanities, social sciences, or business. Electives may not include the MQP.

These may include:

Any International Courses

Item #	Title	Units
INTL 1100	Introduction to International and Global Studies	1/3
INTL 1200	Introduction to Asia	1/3
INTL 1300	Introduction to Latin America	1/3
INTL 2100	Approaches to Global Studies	1/3
INTL 2110	Global Justice	1/3
INTL 2210	Popular Culture and Social Change in Asia	1/3
INTL 2310	Modern Latin America	1/3
INTL 2320	Environmental Justice in the Global Caribbean and Latin America	1/3
INTL 2410	Modern Africa	1/3
INTL 2420	Middle East, North Africa and Mediterranean	1/3
INTL 2510	Contemporary Europe: Union and Disunion	1/3
INTL 2520	Russia Ready: Language and Cultural Context	1/6
INTL 2910	Topics in Global Studies	1/3
INTL 3050	Global Re-Entry Seminar	1/6
INTL 4100	Senior Seminar in International and Global Studies	1/3

Any International and Global History or Social Science Courses

Item #	Title	Units
ENV 1100	Introduction to Environmental Studies	1/3
ENV 1500	Introduction to Geographical Information Systems	1/3
ENV 2200	Environmental Studies in the Various Disciplines	1/3
ENV 2201	Planning for Sustainable Communities	1/3
ENV 2310	Environmental Governance and Innovation	1/3
ENV 2500/PSY 2500	Psychology for Sustainability	1/3
ENV 2600	Environmental Problems in the Developing World	1/3
ENV 2700	Social Media, Social Movements, and the Environment	1/3
ENV 2710	Designing for Climate Resilience and Justice	1/3
ENV 2800	Special Topics in Environmental and Sustainability Studies	
ENV 4400	Senior Seminar in Environmental Studies	1/3
ENV 4800	Special Topics in Environmental and Sustainability Studies	
ENV1100	Introduction to Environmental Studies	1/3
GOV 2319/ENV 2319	Global Environmental Politics	1/3
ID 2050/SS 2050	Social Science Research for the IQP	1/3
INTL 1100	Introduction to International and Global Studies	1/3
INTL 1200	Introduction to Asia	1/3
INTL 1300	Introduction to Latin America	1/3
INTL 2100	Approaches to Global Studies	1/3
INTL 2110	Global Justice	1/3
INTL 2210	Popular Culture and Social Change in Asia	1/3
INTL 2310	Modern Latin America	1/3
INTL 2320	Environmental Justice in the Global Caribbean and Latin America	1/3
INTL 2410	Modern Africa	1/3
INTL 2420	Middle East, North Africa and Mediterranean	1/3
INTL 2510	Contemporary Europe: Union and Disunion	1/3
INTL 2520	Russia Ready: Language and Cultural Context	1/6
INTL 2910	Topics in Global Studies	1/3
INTL 3050	Global Re-Entry Seminar	1/6
INTL 4100	Senior Seminar in International and Global Studies	1/3
SOC 1500	The Sociology of Race	1/3
SS 1505	Games for Understanding Complexity	1/3

Any Foreign Language Courses

Item #	Title	Units
AB 1531	Elementary Arabic I	1/3
AB 1532	Elementary Arabic II	1/3
AB 1533	Elementary Arabic III	1/3
AB 2531	Intermediate Arabic I	1/3
AB 2532	Intermediate Arabic II	1/3
AB 2533	Intermediate Arabic III	1/3
CN 1541	Elementary Chinese I	1/3
CN 1542	Elementary Chinese II	1/3
CN 1543	Elementary Chinese III	1/3
CN 2541	Intermediate Chinese I	1/3
CN 2542	Intermediate Chinese II	1/3
CN 2543	Intermediate Chinese III	1/3
CN 2544	Intermediate Chinese IV	1/3
CN 3541	Advanced Chinese I	1/3
CN 3542	Advanced Chinese II	1/3
CN 3543	Advanced Chinese III	1/3
CN 3561	Business Chinese	1/3
GN 1511	Elementary German I: Identities and Communities	1/3
GN 1512	Elementary German II: Navigating Everyday Life in German-speaking Contexts	1/3
GN 2511	Intermediate German I: Cultural Practices and Products of the German-Speaking World	1/3
GN 2512	Intermediate German II: Pasts, Presents, and Futures of the German-Speaking World	1/3
GN 3511	Advanced German I: Exploration and Innovation in the German-Speaking World	1/3
GN 3512	Advanced German II: National Identities and Stories	1/3
GN 3513	Survey of German Civilization and Culture from 1871 to the Present	1/3
GN 3514	Seminar on Selected Topics in German Literature	1/3
GN 3516	German Film	1/3
ID 3525/SP 3525	Spanish American Film/Media: Cultural Issues	1/3
ID 3526/SP 3526	Comparative Business Environments	1/3
ID 3527/SP 3527	Technical and Business Spanish	1/3
ID 3529/SP 3529	Caribbeanness: Voices of the Spanish Caribbean	1/3
ID 3530/SP 3530	Spanish Film/Media: Cultural Issues	1/3
ID 3531/SP 3531	Contemporary Us Latino Literature & Culture	1/3
SP 1523	Elementary Spanish I	1/3
SP 1524	Elementary Spanish II	1/3
SP 2521	Intermediate Spanish I	1/3
SP 2522	Intermediate Spanish II	1/3
SP 3521	Advanced Spanish I	1/3
SP 3522	Advanced Spanish II	1/3
SP 3523	Topics in Latin American Culture	1/3
SP 3524	Spanish-American Literature in the Twentieth Century	1/3
SP 3528	Spanish Culture and Civilization	1/3
SP 3532	Studies in Spanish Literature: Artistic Expression and Nation Building	1/3
SP 3533	Ecocrítica: Environmental Cultural Production in Latin America	1/3
SP 3534	Intersections of Science, Engineering, Art, Literature, and Film in Latin America and the Caribbean	1/3

First-Year Course

Item #	Title	Units
FY 1100 & FY 1101	The Great Problems Seminars	1/3
FY 1800	Discovering Majors and Careers	1/12

International and Global Courses in Business

Item #	Title	Units
AR 1111	Introduction to Art History	1/3
BUS 1020	Global Environment of Business Decisions	1/3
MU 3001	World Music	1/3
PY 2716/RE 2716	Gender, Race, and Class	1/3

Senior Seminar in International and Global Studies (Minimum 1/3 Units)

This seminar may be taken at any time after an International and Global Experience. With the approval of the Program Review Committee, the seminar may be completed via independent study.

Item #	Title	Units
INTL 4100	Senior Seminar in International and Global Studies	1/3

International and Global Experience

All International and Global Studies minors are required to have a study abroad experience that should be educational in nature and equivalent in length to at least one WPI term. All WPI global projects and exchange programs completed at projects centers outside of the United States meet this requirement. If approved by the Program Review Committee, global projects completed in the United States or international educational programs and/or internships sponsored by other organizations also may satisfy this requirement.

WPI policy requires that no more than one unit of course work can be double counted toward other degree requirements. Thus, students may count three courses for the minor taken to fulfill other degree requirements (such as the Humanities and Arts Requirement or two course requirement in the Social Sciences) as long as one unit of the minor does not double-count. In other words, students must take INTL 4100 and two other courses for this minor that do not count for another degree requirement.

Mathematical Sciences

HEAD: S. OLSON, William Steur Professor; ASSOCIATE HEAD: F. Zou

PROFESSORS: J. Fehribach, A. Heinricher, M. Humi, C. Larsen, K. Lurie, W. Martin, B. Nandram, S. Olson, M. Sarkis, B. Servatius, D. Tang, B. Tilley, B. Vernescu, D. Volkov, S.Weekes, Z. Wu

ASSOCIATE PROFESSORS: R. Paffenroth, Q. Song, S. Sturm, S. Walcott, F. Wang, G. Wang, M. Wu, Z. Zhang, J. Zou

ASSISTANT PROFESSORS: A. Arnold, F. Bernardi, O. Mangoubi, G. Peng, A. Sales, A. Wagner

PROFESSOR OF PRACTICE: J. Abraham, C.S. Thorp

PROFESSOR OF TEACHING: M. Blais, J. Goulet

ASSOCIATE PROFESSORS OF TEACHING: M. Johnson,B. Peiris, B. Posterro

ASSISTANT PROFESSOR OF TEACHING: D. Rassias, H. Servatius, W. Sanguinet, S. Tripp

SENIOR INSTRUCTOR: T. Doytchinova

RESEARCH PROFESSOR: V. Druskin

RESEARCH ASSOCIATE PROFESSOR: V. Yakovlev

POST-DOCTORAL SCHOLARS: N. Buczkowski, E. Caceres, T. De Alwis, B. Gu, N. Jayaweera, N. Urichchio, Q. Zhuang

EMERITUS PROFESSORS: P. Christopher, P. Davis, W. Farr, W. Hardell, R. Jui, J.J. Malone, B. McQuarrie, U. Mosco, J. Petrucelli, D. Vermes, H. Walker

ASSOCIATED FACULTY: F. Emdad (CS), G. Sarkozy (CS), A. Trapp (BUS)

Mission Statement

Recognizing the vital role that mathematical sciences play in today's society, the Mathematical Sciences Department provides leading-edge programs in education, research, and professional training in applied and computational mathematics and statistics. These programs are enhanced and distinguished by project-oriented education and collaborative involvement with industry, national research centers, and the international academic community.

Program Educational Objectives

The department's major programs provide students with preparation for effective and successful professional careers in the mathematical sciences, whether in traditional academic pursuits or in the many new career areas available in today's technologically sophisticated, globally interdependent society. Through course work, students acquire a firm grounding in fundamental mathematics and selected areas of emphasis. Projects, which often involve interdisciplinary and industrial applications, offer further opportunities to gain mathematical depth and to develop skills in problem-solving, communication, teamwork, and self-directed learning, together with an understanding of the role of the mathematical sciences in the contemporary world.

Program Outcomes

We expect graduates to:

1. Have a solid knowledge of a broad range of mathematical principles and techniques and the ability to apply them.
2. Be able to read, write, and communicate mathematics inside and outside the discipline.
3. Have the ability to formulate mathematical statements and prove or disprove them.
4. Be able to formulate and investigate mathematical questions and conjectures.
5. Understand fundamental axiom systems and essential definitions and theorems.
6. Be able to formulate and analyze mathematical or statistical models.
7. Have the ability to apply appropriate computational technology to analyze and solve mathematical problems.
8. Be able to learn independently and as part of a team, and to demonstrate a depth of knowledge in at least one area of the mathematical sciences.

The Department of Mathematical Sciences at WPI offers:

1. the Bachelor of Science degree in Mathematical Sciences;
2. the Bachelor of Science degree in Actuarial Mathematics;
3. a Minor in Mathematics;
4. a Minor in Statistics;
5. a combined B.S./M.S. degree in Applied Mathematics, Applied Statistics, or Industrial Mathematics.

The second digit in mathematical sciences course numbers is coded as follows:

0 — Basic
2 — Applied mathematics (general)
4 — Applied mathematics (differential equations)
6 — Statistics and probability
8 — Mathematics (general)

Actuarial Mathematics Major

Degree Type
Bachelor of Science

Actuaries provide financial evaluations of risk that help professionals in the insurance and finance industries, and many in large corporations and government agencies make strategic management decisions. Fellowship in the Society of Actuaries or the Casualty Actuarial Society – achieved by passing a series of examinations – is the most widely accepted standard of professional qualification to practice as an actuary.

WPI's program enables students to take the first steps toward preparing for these exams and introduces these majors to the fundamentals of business and economics.

Students interested in pursuing a degree in Actuarial Mathematics should contact Professor Abraham, the Coordinator of the Actuarial Mathematics Program, as soon as possible.

Program Distribution Requirements for the Actuarial Mathematics Major

The normal period of residency at WPI is 16 terms. In addition to the WPI requirements applicable to all students, completion of a minimum of 10 units of study is required as follows:

Mathematics Requirement (including MQP) (Minimum 22/3 Units)

Must include the following, or their equivalent.

Required Mathematical Science Courses

Item #	Title	Units
MA 3212	Actuarial Mathematics I	1/3
MA 3631	Mathematical Statistics	1/3
MA 3831	Principles of Real Analysis I	1/3
MA 3832	Principles of Real Analysis II	1/3

Must include at least one of the following, or their equivalent.

Elective Numerical Methods Courses

Item #	Title	Units
CS 4032/MA 3257	Numerical Methods for Linear and Nonlinear Systems	1/3
CS 4033/MA 3457	Numerical Methods for Calculus and Differential Equations	1/3

Must include three of the following, or their equivalent.

Transitional Courses

Item #	Title	Units
MA 1033	Theoretical Calculus III	1/3
MA 1971	Bridge to Higher Mathematics	1/3
MA 2073	Matrices and Linear Algebra II	1/3
MA 2211	Theory of Interest I	1/3
MA 2251	Vector and Tensor Calculus	1/3
MA 2271	Graph Theory	1/3
MA 2273	Combinatorics	1/3
MA 2431	Mathematical Modeling with Ordinary Differential Equations	1/3
MA 2631	Probability Theory	1/3

NOTE: Only one of MA 1033 and MA 1971 may count towards this Transition Course requirement.

Must include three of the following, or their equivalent.

Elective Actuarial Mathematics Courses

Item #	Title	Units
MA 2212	Theory of Interest II	1/3
MA 3213	Actuarial Mathematics II	1/3
MA 4213	Loss Models I - Risk Theory	1/3
MA 4214	Loss Models II - Survival Models	1/3
MA 4892	Topics in Actuarial Mathematics	1/3

Note: Experimental and Special Topics Courses with Actuarial relevant topics can also be counted as Elective Actuarial Courses.
Only one of MA 2631 and MA 2621 may count towards the WPI undergraduate degree.

May include independent studies directed towards Society of Actuaries exams only if the material was not previously covered in a WPI course.

Basic Science Requirement (Minimum 2/3 Units)

Courses must be chosen from the following disciplines: BB, CH, ES, GE, or PH.

Biology and Biotechnology (BB) Courses

Item #	Title	Units
BB 1001	Introduction to Biology	1/3
BB 1002	Environmental Biology	1/3
BB 1003/BCB 1003	Exploring Bioinformatics and Computational Biology	1/3
BB 1025	Human Biology	1/3
BB 1035	Biotechnology	1/3
BB 1045	Biodiversity	1/3
BB 2002	Microbiology	1/3
BB 2003	Fundamentals of Microbiology	1/3
BB 2030	Plant Diversity	1/3
BB 2040	Principles of Ecology	1/3
BB 2050	Animal Behavior	1/3
BB 2550	Cell Biology	1/3
BB 2902	Enzymes, Proteins, and Purification	1/6
BB 2903	Anatomy and Physiology	1/6
BB 2904	Ecology, Environment, and Animal Behavior	1/6
BB 2915	Searching for Solutions in Soil: Microbial and Molecular Investigations	1/3
BB 2917	Hunting for Phage	1/3
BB 2920	Genetics	1/3
BB 2950	Molecular Biology	1/3
BB 3003	Medical Microbiology: Plagues of the Modern World, a Case Study Approach	1/3
BB 3010/BCB 3010	Simulation in Biology	1/3
BB 3050	Cancer Biology	1/3
BB 3080	Neurobiology	1/3
BB 3101	Human Anatomy & Physiology: Movement and Communication	1/3
BB 3102	Human Anatomy & Physiology: Transport and Maintenance	1/3
BB 3120	Plant Physiology	1/3
BB 3140	Evolution: Pattern and Process	1/3
BB 3512	Molecular Genetics Lab	1/6
BB 3513	Cell Culture Techniques for Animal Cells	1/6
BB 3515	Physiologic Systems Laboratory	1/3
BB 3517	Fermentation	1/6
BB 3519	Protein Purification	1/6
BB 3521	Microscopy	1/6
BB 3525	Plant Physiology	1/6
BB 3526	Phage Hunters: the Analysis	1/6
BB 3527	Molecular Biology and Genetic Engineering: Approaches and Applications	1/3
BB 3530	Immunotherapies: The Next Generation of Pharmaceuticals	1/3
BB 3570	Cell Culture Models for Tissue Regeneration	1/3
BB 3620	Developmental Biology	1/3
BB 3920	Immunology	1/3
BB 4150	Environmental Change: Problems and Approaches	1/3
BB 4170/CH 4170	Experimental Genetic Engineering	1/3
BB 4190/CH 4190	Regulation of Gene Expression	1/3
BB 4260	Synthetic Biology	1/3
BB 4801/BCB 4001	Bioinformatics	1/3
BB 4900	Capstone Experience in Biology and Biotechnology	1/3

Chemistry and Biochemistry (CH) Courses

Item #	Title	Units
BB 4170/CH 4170	Experimental Genetic Engineering	1/3
BB 4190/CH 4190	Regulation of Gene Expression	1/3
CH 1010	Chemical Properties, Bonding, and Forces	1/3
CH 1020	Chemical Reactions	1/3
CH 1030	Kinetics, Equilibrium and Thermodynamics	1/3
CH 1040	Spectroscopy in Organic and Polymer Chemistry	1/3
CH 2310	Organic Chemistry I	1/3
CH 2320	Organic Chemistry II	1/3
CH 2330	Organic Chemistry III	1/3
CH 2360	Organic Laboratory	1/3
CH 2640	Experimental Chemistry I: Instrumental Analysis	1/3
CH 2650	Modern Physical Chemistry Methods	1/3
CH 2660	Organic Synthesis and Analysis Laboratory	1/3
CH 2670	Investigation of Coordination Complexes Through Inquiry	1/3
CH 3310	Advanced Organic Chemistry	1/3
CH 3410	Structure, Bonding, and Reactivity in Inorganic Chemistry	1/3
CH 3510	Chemical Thermodynamics	1/3
CH 3530	Quantum Chemistry	1/3
CH 3550	Chemical Dynamics	1/3
CH 4110	Protein Structure and Function	1/3
CH 4120	Lipids and Biomembrane Functions	1/3
CH 4130	Nucleic Acids and Bioinformation	1/3
CH 4140	Metabolism and Disease	1/3
CH 4150	Enzymology and Protein Characterization Laboratory	1/3
CH 4160	Membrane Biophysics	1/3
CH 4330	Organic Synthesis	1/3
CH 4420	Principles and Applications of Group Theory in Chemistry	1/3
CH 4520	Chemical Statistical Mechanics	1/3

Engineering Science Interdisciplinary (ES) Courses

Item #	Title	Units
ES 1020	Introduction to Engineering	1/3
ES 1310	Introduction to Computer Aided Design	1/3
ES 1500	Fundamentals of Systems Thinking	1/3
ES 2001	Introduction to Materials Science	1/3
ES 2501	Introduction to Static Systems	1/3
ES 2502	Stress Analysis	1/3
ES 2503	Introduction to Dynamic Systems	1/3
ES 2800	Environmental Impacts of Engineering Decisions	1/3
ES 3001	Introduction to Thermodynamics	1/3
ES 3002	Mass Transfer	1/3
ES 3003	Heat Transfer	1/3
ES 3004	Fluid Mechanics	1/3
ES 3011	Control Engineering I	1/3
ES 3323	Advanced Computer Aided Design	1/3
ES 3501	A Project-Based Introduction to Systems Engineering	1/3

Geosciences (GE) Courses

Item #	Title	Units
GE 2341	Geology	1/3

Physics (PH) Courses

Item #	Title	Units
PH 1110	General Physics—Mechanics	1/3
PH 1111	Principles of Physics—Mechanics	1/3
PH 1120	General Physics—Electricity and Magnetism	1/3
PH 1121	Principles of Physics—Electricity and Magnetism	1/3
PH 1130	Modern Physics	1/3
PH 1140	Oscillations and Waves	1/3
PH 1150	Introductory Physics of Living Systems	1/3
PH 2101	Principles of Thermodynamics	1/3
PH 2201	Intermediate Mechanics I	1/3
PH 2202	Intermediate Mechanics II	1/3
PH 2301	Electromagnetic Fields	1/3
PH 2501	Photonics	1/3
PH 2502	Lasers	1/3
PH 2510	Atomic Force Microscopy	1/3
PH 2520	Introduction to Astrophysics	1/3
PH 2540	Solar Systems	1/3
PH 2550/AE 2550	Atmospheric and Space Environments	1/3
PH 2601	Photonics Laboratory	1/3
PH 2651	Intermediate Physics Laboratory	1/3
PH 3206	Statistical Physics	1/3
PH 3301	Electromagnetic Theory	1/3
PH 3401	Quantum Mechanics I	1/3
PH 3402	Quantum Mechanics II	1/3
PH 3501	Relativity	1/3
PH 3502	Solid State Physics	1/3
PH 3503	Nuclear Physics	1/3
PH 3504	Optics	1/3
PH 4201/PH 511	Advanced Classical Mechanics	1/3

Computer Science or Data Science Requirement (Minimum 2/3 Units)

Computer Science (CS) Courses

Item #	Title	Units
BCB 4002/CS 4802	Biovisualization	1/3
BCB 4003/CS 4803	Biological and Biomedical Database Mining	1/3
CS 1004	Introduction to Programming for Non-Majors	1/3
CS 1101	Introduction to Program Design	1/3
CS 1102	Accelerated Introduction to Program Design	1/3
CS 2011	Introduction to Machine Organization and Assembly Language	1/3
CS 2022/MA 2201	Discrete Mathematics	1/3
CS 2102	Object-Oriented Design Concepts	1/3
CS 2103	Accelerated Object-Oriented Design Concepts	1/3
CS 2119	Application Building with Object-Oriented Concepts	1/3
CS 2223	Algorithms	1/3
CS 2301	Systems Programming for Non-Majors	1/3
CS 2303	Systems Programming Concepts	1/3
CS 3013	Operating Systems	1/3
CS 3041	Human-Computer Interaction	1/3
CS 3043	Social Implications of Information Processing	1/3
CS 3133	Foundations of Computer Science	1/3
CS 3431	Database Systems I	1/3
CS 3516	Computer Networks	1/3
CS 3733	Software Engineering	1/3
CS 4032/MA 3257	Numerical Methods for Linear and Nonlinear Systems	1/3
CS 4033/MA 3457	Numerical Methods for Calculus and Differential Equations	1/3
CS 4099	Special Topics in Computer Science	1/3
CS 4100/IMGD 4100	Artificial Intelligence for Interactive Media and Games	1/3
CS 4120	Analysis of Algorithms	1/3
CS 4123	Theory of Computation	1/3
CS 4233	Object-Oriented Analysis and Design	1/3
CS 4241	Webware: Computational Technology for Network Information Systems	1/3
CS 4300/IMGD 4300	Graphics, Simulation, and Aesthetics	1/3
CS 4341	Introduction to Artificial Intelligence	1/3
CS 4342	Machine Learning	1/3
CS 4401	Software Security Engineering	1/3
CS 4404	Tools and Techniques in Computer Network Security	1/3
CS 4432	Database Systems II	1/3
CS 4433/DS 4433	Big Data Management and Analytics	1/3
CS 4445	Data Mining and Knowledge Discovery in Databases	1/3
CS 4513	Distributed Computing Systems	1/3
CS 4515	Computer Architecture	1/3
CS 4516	Advanced Computer Networks	1/3
CS 4518	Mobile and Ubiquitous Computing	1/3
CS 4533	Techniques of Programming Language Translation	1/3
CS 4536	Programming Languages	1/3
CS 4731	Computer Graphics	1/3
CS 4732	Computer Animation	1/3
CS 4801/ECE 4802	Introduction to Cryptography and Communication Security	1/3
CS 4804	Data Visualization	1/3
MA 3457/CS 4033	Numerical Methods for Calculus and Differential Equations	1/3

Data Science (DS) Courses

Item #	Title	Units
CS 4433/DS 4433	Big Data Management and Analytics	1/3
CS 4804	Data Visualization	1/3
DS 1010	Data Science I: Introduction to Data Science	1/3
DS 2010	Data Science II: Modeling and Data Analysis	1/3
DS 3010	Data Science III: Computational Data Intelligence	1/3
DS 4635/MA 4635	Data Analytics and Statistical Learning	1/3

NOTE: Only one of DS 1010, CS 2022 and CS 3043 may count towards the Computer Science and Data Science Requirement.

Business Requirement (Minimum 4/3 Units)

Business school courses must be chosen from courses with any of the following prefixes: ACC, BUS, or FIN. ACC 2060, FIN 2070, and FIN 3300 are recommended. Business school courses may not include FIN 1250.

Item #	Title	Units
ACC 2060	Financial Statements for Decision Making	1/3
FIN 2070	Risk Analysis for Decision Making	1/3
FIN 3300	Finance & Technology (FinTech)	1/3

Accounting (ACC) Courses

Item #	Title	Units
ACC 2060	Financial Statements for Decision Making	1/3
ACC 2101	Management Accounting	1/3

Business (BUS) Courses

Item #	Title	Units
BUS 1020	Global Environment of Business Decisions	1/3
BUS 2001	WPI Means Business	1/3
BUS 2020	The Legal Environment of Business Decisions	1/3
BUS 2080	Data Analysis for Decision Making	1/3
BUS 4300	Senior Seminar	1/3
MIS 2300	Business Applications of Blockchain	1/3
MIS 3010	Creating Value Through Innovation	1/3
MKT 4030	Achieving Strategic Effectiveness	1/3
OBC 1010	Leadership Practice	1/3
OIE 3020	Achieving Effective Operations	1/3

Finance & Technology (FIN) Courses

Item #	Title	Units
FIN 2070	Risk Analysis for Decision Making	1/3
FIN 3300	Finance & Technology (FinTech)	1/3
FIN 3310	Financial Markets and Digital Currencies	1/3
FIN 3330	Financial Analysis	1/3

Actuarial Seminar (Minimum 0/3 Units)

The actuarial seminar is a graduation requirement. Students must complete this seminar in at least four terms while at WPI. Please consult with the actuarial faculty for more details about this requirement.

Projects

Off-campus qualifying projects are regularly done in collaboration with insurance companies, and have in the past been sponsored by Aetna, Blue Cross Blue Shield, Hanover, John Hancock, Sun Life, Travelers and Unum. Visit http://www.wpi.edu/+CIMS. These projects give real-world experience of the actuarial field by having students involved in solving problems faced by professional actuaries. Instead of choosing a project already posed by a company/advisor team, students may instead seek out industry-sponsored projects on their own (often through internship connections) and propose them to a potential faculty advisor. Alternatively, students may choose to complete any other project in mathematics.

Program Chart and/or Course Flow Chart

ACTUARIAL MATHEMATICS MAJOR PROGRAM CHART

UNIVERSITY REQUIREMENTS	
Minimum Academic Credit	15 units
Residency	8 units
Free Electives	3/3 units
Humanities and Arts	6/3 units
Interactive Qualifying Project	3/3 units
Major Qualifying Project	3/3 units
Social Science	2/3 units
Physical Education	1/3 units

FOUNDATION COURSES

INTRODUCTORY AND OTHER MA COURSES (8/3 Units Required)	TRANSITION COURSES (3/3 Units Required)	CORE COURSES (1/3 Units Required)	ACTUARIAL COURSES (4/3 Units Required)
Any MA courses. Suggestions include MA 1021 – 1024 or MA 1033 – 1034, MA 1801†, MA 1971, MA 2051, MA 2071‡ or MA 2072‡, MA 2201, MA 2210, MA 2611, MA 2612, MA 2621‡‡ or MA 2631‡‡, MA 3231, MA 3625*, MA 4235*, MA 4237*, MA 4635	One of MA1033 or MA1971 MA 2073 MA 2211 MA 2251 MA 2271* MA 2273* MA 2431 MA 2631‡‡	Statistics: MA 3631 Analysis: Both MA 3831 and MA 3832 Computation: One of MA 3257 or MA 3457	Must include MA 3212 AND Three of the following: MA 2212, MA 3213 MA 4213, MA 4214 MA 4892, other Actuarial Courses**

OTHER REQUIREMENTS

ACTUARIAL SEMINAR	BASIC SCIENCE (2/3 Units Required)	COMPUTER or DATA SCIENCE (2/3 Units Required)	BUSINESS (4/3 Units Required)
MA 4216 – four terms	Any BB, CH, ES, GE, or PH courses	Any CS or DS courses. Can only include one of DS 1010, CS 2022, and CS 3403	Any ACC, BUS, or FIN course (except FIN 1250) Recommended courses: ACC 2060, FIN 2070, and FIN 3300

† MA 1801 is 1/12 unit and can be taken four times to be equivalent to a 1/3 unit course; ‡‡ WPI credit can only be received for either MA 2071 or MA 2072 and either MA 2621 or MA 2631; *Category II Courses, offered in alternating years; ** The department may run additional Actuarial Courses as Experimental Courses; Note that each class, including cross-listed classes (e.g. MA 2201/CS 2202), may only count towards one distribution requirement.

ACTUARIAL MATHEMATICS MAJOR PROGRAM CHART

UNIVERSITY REQUIREMENTS	
Minimum Academic Credit	15 units
Residency	8 units
Free Electives	3/3 units
Humanities and Arts	6/3 units
Interactive Qualifying Project	3/3 units
Major Qualifying Project	3/3 units
Social Science	2/3 units
Physical Education	1/3 units

FOUNDATION COURSES

INTRODUCTORY AND OTHER MA COURSES (8/3 Units Required)	TRANSITION COURSES (3/3 Units Required)	CORE COURSES (1/3 Units Required)	ACTUARIAL COURSES (4/3 Units Required)
Any MA courses. Suggestions include MA 1021 – 1024 or MA 1033 – 1034, MA 1801†, MA 1971, MA 2051, MA 2071‡ or MA 2072‡, MA 2201, MA 2210, MA 2611, MA 2612, MA 2621‡‡ or MA 2631‡‡, MA 3231, MA 3625*, MA 4235*, MA 4237*, MA 4635	One of MA1033 or MA1971 MA 2073 MA 2211 MA 2251 MA 2271* MA 2273* MA 2431 MA 2631‡‡	Statistics: MA 3631 Analysis: Both MA 3831 and MA 3832 Computation: One of MA 3257 or MA 3457	Must include MA 3212 AND Three of the following: MA 2212, MA 3213 MA 4213, MA 4214 MA 4892, other Actuarial Courses**

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Mathematical Sciences Major

Degree Type

Bachelor of Science

Projects

Some of the most active career directions in the mathematical sciences are reflected in the MQP areas around which the department's offerings are organized: Algebraic and Discrete Mathematics, Computational and Applied Analysis, Operations Research, and Probability and Statistics. As early as practical, and certainly no later than the sophomore year, the mathematical sciences major should begin exploring these different areas. The transition courses, MA 1033, MA 1971, MA 2073, MA 2211, MA 2251, MA 2271, MA 2273, MA 2431, MA 2631, and MA 3631 are specifically designed to introduce various MQP areas while preparing the student for advanced courses and the MQP. The student should talk to faculty in the student's area of interest to develop and select an MQP and MQP advisor.

While most students choose MQPs in one of the four areas mentioned above, it is possible to design an MQP that does not fit into any one area. In such cases, students will want to take special care to plan their programs carefully with their advisors so that sufficient background is obtained before beginning to do research. Independent studies are a good way for students to learn topics that are not taught in regularly-scheduled courses. Interested students should approach faculty with requests for independent studies.

Through the Center for Industrial Mathematics and Statistics (CIMS), students can use their mathematics and statistics training to work on real-world problems that come from sponsors in industry and finance. More information about industrial MQPs and projects can be found at http://www.wpi.edu/+CIMS.

The following sections contain, for each MQP area:

- A brief description of the area including the kinds of challenges likely to be encountered by MQP students and mathematical scientists working there.
- Courses of interest.

Algebraic and Discrete Mathematics

Algebraic and discrete mathematics is recognized as an increasingly important and vital area of mathematics. Many of the fundamental ideas of discrete mathematics play an important role in formulating and solving problems in a variety of fields ranging from ecology to computer science. For instance, graph theory has been used to study competition of species in ecosystems, to schedule traffic lights at an intersection, and to synchronize parallel processors in a computer. Coding theory has been applied to problems from the private and public sectors where encoding and decoding information securely is the goal. In turn, the problems to which discrete mathematics is applied often yield new and interesting mathematical questions. The goal of a project in discrete mathematics would be to experience this interaction between theory and application. To begin, a typical project team would assess the current state of a problem and the theory that is relevant. Once this is done, the project team's objective would be to make a contribution to solving the problem by developing new mathematical results.

In working in discrete mathematics, one may be writing algorithms, using the computer as a modeling tool, and using the computer to test conjectures. It is important that a student interested in this area have some computer proficiency. Depending on the project, an understanding of algorithm analysis and computational complexity may be helpful.

Courses of Interest

Item #	Title	Units
CS 2301	Systems Programming for Non-Majors	1/3
CS 4120	Analysis of Algorithms	1/3
CS 4123	Theory of Computation	1/3
MA 2271	Graph Theory	1/3
MA 2273	Combinatorics	1/3
MA 3231	Linear Programming	1/3
MA 3233	Discrete Optimization	1/3
MA 3823	Group Theory	1/3
MA 3825	Rings and Fields	1/3
MA 4891	Topics in Mathematics	1/3

Computational and Applied Analysis

This area of mathematics concerns the modeling and analysis of continuous physical or biological processes that occur frequently in science and engineering. Students interested in this area should have a solid background in analysis which includes the ability to analyze ordinary and partial differential equations through both analytical and computational means.

In most circumstances, an applied mathematician does not work alone but is part of a team consisting of scientists and engineers. The mathematician's responsibility is to formulate a mathematical model from the problem, analyze the model, and then interpret the results in light of the experimental evidence. It is, therefore, important for students to have some experience in mathematical modeling and secure a background in one branch of science or engineering through a carefully planned sequence of courses outside of the department.

With the increase in computational power, many models previously too complicated to be solvable, can now be solved numerically. It is, therefore, recommended that students acquire enough computer proficiency to take advantage of this. Computational skills are important in applied mathematics. Students may learn these skills through various numerical analysis courses offered by the department. An MQP in this area will generally involve the modeling of a real-life problem, analyzing it, and solving it numerically.

Courses of Interest

Item #	Title	Units
CS 4032/MA 3257	Numerical Methods for Linear and Nonlinear Systems	1/3
CS 4033/MA 3457	Numerical Methods for Calculus and Differential Equations	1/3
MA 2251	Vector and Tensor Calculus	1/3
MA 2431	Mathematical Modeling with Ordinary Differential Equations	1/3
MA 3231	Linear Programming	1/3
MA 3457/CS 4033	Numerical Methods for Calculus and Differential Equations	1/3
MA 3471	Advanced Ordinary Differential Equations	1/3
MA 3475	Calculus of Variations	1/3
MA 4222	Top Algorithms in Applied Mathematics	1/3
MA 4235	Mathematical Optimization	1/3
MA 4291	Applied Complex Variables	1/3
MA 4411	Numerical Analysis of Differential Equations	1/3
MA 4451	Boundary Value Problems	1/3
MA 4473	Partial Differential Equations	1/3

Operations Research

Operations research is an area of mathematics which seeks to solve complex problems that arise in conducting and coordinating the operations of modern industry and government. Typically, operations research looks for the best or optimal solutions to a given problem. Problems within the scope of operations research methods are as diverse as finding the lowest cost school bus routing that still satisfies racial guidelines, deciding whether to build a small plant or a large plant when demand is uncertain, or determining how best to allocate timesharing access in a computer network.

Typically, these problems are solved by creating and then analyzing a mathematical model to determine an optimal strategy for the organization to follow. Often the problem requires a statistical model, and nearly always the analysis - whether optimizing through a set of equations or simulating the behavior of a process - involves the use of a computer. Finally, operations researchers must be able to interpret and apply the results of their analyses in an appropriate manner.

In addition to a solid background in calculus, probability and statistics, and the various operations research areas, prospective operations researchers should be familiar with computer programming and managerial techniques.

Courses of Interest

Item #	Title	Units
BUS 2080	Data Analysis for Decision Making	1/3
MA 2271	Graph Theory	1/3
MA 2273	Combinatorics	1/3
MA 3231	Linear Programming	1/3
MA 3233	Discrete Optimization	1/3
MA 3627	Introduction to the Design and Analysis of Experiments	1/3
MA 3631	Mathematical Statistics	1/3
MA 4222	Top Algorithms in Applied Mathematics	1/3
MA 4235	Mathematical Optimization	1/3
MA 4237	Probabilistic Methods in Operations Research	1/3
MA 4631	Probability and Mathematical Statistics I	1/3
MA 4632	Probability and Mathematical Statistics II	1/3
OIE 3460	Simulation Modeling and Analysis	1/3
OIE 3510	Stochastic Models	1/3

Probability and Statistics

In many areas of endeavor, decisions must be made using information which is known only partially or has a degree of uncertainty attached to it. One of the major tasks of the statistician is to provide effective strategies for obtaining the relevant information and for making decisions based on it. Probabilists and statisticians are also deeply involved in stochastic modeling - the development and application of mathematical models of random phenomena. Applications to such areas as medicine, engineering, and finance abound.

Students interested in becoming probabilists or mathematical statisticians should consider additional study in graduate school. While graduate study is an option for students whose goals are to be applied statisticians, there are also career opportunities in business, industry, and government for holders of a Bachelor's degree. More information about careers in statistics can be found at the American Statistical Association's web site http://www.amstat.org/careers.

Students planning on graduate studies in this area would be well advised to consider, in addition to the courses of interest listed below, additional independent study or PQP work in probability and statistics, or some of the department's statistics graduate offerings.

Courses of Interest

Item #	Title	Units
DS 4635/MA 4635	Data Analytics and Statistical Learning	1/3
MA 2611	Applied Statistics I	1/3
MA 2612	Applied Statistics II	1/3
MA 2631	Probability Theory	1/3
MA 3627	Introduction to the Design and Analysis of Experiments	1/3
MA 3631	Mathematical Statistics	1/3
MA 4237	Probabilistic Methods in Operations Research	1/3
MA 4631	Probability and Mathematical Statistics I	1/3
MA 4632	Probability and Mathematical Statistics II	1/3

Program Distribution Requirements for the Mathematical Sciences Major

The normal period of residency at WPI is 16 terms. In addition to the WPI requirements applicable to all students, completion of a minimum of 10 units of study is required as follows.

Mathematics Requirement including MQP (Minimum 22/3 Units)[1,2]

Must include at least one of the following, or their equivalent

Introductory Courses (8/3 Units)

Any MA courses. Suggestions: MA 1021 – 1024 or MA 1033 – 1034, MA 1801‡, MA 1971, MA 2051, MA 2071‡ or MA 2072‡, MA 2201, MA 2210, MA 2211, MA 2212, MA 2611, MA 2612, MA 2621‡‡ or MA 2631‡‡

Item #	Title	Units
CS 2022/MA 2201	Discrete Mathematics	1/3
MA 1020	Calculus I with Preliminary Topics	1/3
MA 1021	Calculus I	1/3
MA 1022	Calculus II	1/3
MA 1023	Calculus III	1/3
MA 1024	Calculus IV	1/3
MA 1033	Theoretical Calculus III	1/3
MA 1034	Theoretical Calculus IV	1/3
MA 1801	Denksport	1/12
MA 1971	Bridge to Higher Mathematics	1/3
MA 2051	Ordinary Differential Equations	1/3
MA 2071	Matrices and Linear Algebra I	1/3
MA 2072	Accelerated Matrices and Linear Algebra I	1/3
MA 2210	Mathematical Methods in Decision Making	1/3
MA 2211	Theory of Interest I	1/3
MA 2212	Theory of Interest II	1/3
MA 2611	Applied Statistics I	1/3
MA 2612	Applied Statistics II	1/3
MA 2621	Probability for Applications	1/3
MA 2631	Probability Theory	1/3

Transition Courses (4/3 Unit)

One of MA 1033 or MA 1971, MA 2073, MA 2211, MA 2251, MA 2271*, MA 2273*, MA 2431, MA 2631‡‡, MA 3631

Item #	Title	Units
MA 1033	Theoretical Calculus III	1/3
MA 1971	Bridge to Higher Mathematics	1/3
MA 2073	Matrices and Linear Algebra II	1/3
MA 2211	Theory of Interest I	1/3
MA 2251	Vector and Tensor Calculus	1/3
MA 2271	Graph Theory	1/3
MA 2273	Combinatorics	1/3
MA 2431	Mathematical Modeling with Ordinary Differential Equations	1/3
MA 2631	Probability Theory	1/3
MA 3631	Mathematical Statistics	1/3

Core Courses (1/3 Unit)

Analysis

Item #	Title	Units
MA 3831	Principles of Real Analysis I	1/3
MA 3832	Principles of Real Analysis II	1/3

Computation

Item #	Title	Units
CS 4032/MA 3257	Numerical Methods for Linear and Nonlinear Systems	1/3
MA 3457/CS 4033	Numerical Methods for Calculus and Differential Equations	1/3

Algebra

Item #	Title	Units
MA 3823	Group Theory	1/3
MA 3825	Rings and Fields	1/3

Upper Level Courses (3/3 Unit)

Any 3000-Level or higher course, including experimental and special topics courses.

Actuarial Math

Item #	Title	Units
MA 3212	Actuarial Mathematics I	1/3
MA 4213	Loss Models I - Risk Theory	1/3
MA 4214	Loss Models II - Survival Models	1/3
MA 4892	Topics in Actuarial Mathematics	1/3

Analysis: MA 3471*, MA 3475*, MA 4291, MA 4451, MA 4473*, MA 4895*

Item #	Title	Units
MA 3471	Advanced Ordinary Differential Equations	1/3
MA 3475	Calculus of Variations	1/3
MA 4291	Applied Complex Variables	1/3
MA 4451	Boundary Value Problems	1/3
MA 4473	Partial Differential Equations	1/3
MA 4895	Differential Geometry	1/3

Algebra/Discrete: MA 3233*, MA 3823, MA 3825*

Item #	Title	Units
MA 3233	Discrete Optimization	1/3
MA 3823	Group Theory	1/3
MA 3825	Rings and Fields	1/3

Computational Math: MA 3257, MA 3457, MA 4411*, MA 4222*

Item #	Title	Units
CS 4032/MA 3257	Numerical Methods for Linear and Nonlinear Systems	1/3
MA 3457/CS 4033	Numerical Methods for Calculus and Differential Equations	1/3
MA 4222	Top Algorithms in Applied Mathematics	1/3
MA 4411	Numerical Analysis of Differential Equations	1/3

Operations Research: MA 3231, MA 3233*, MA 4235*, MA 4237*

Item #	Title	Units
MA 3231	Linear Programming	1/3
MA 3233	Discrete Optimization	1/3
MA 4235	Mathematical Optimization	1/3
MA 4237	Probabilistic Methods in Operations Research	1/3

Statistics/Probability: MA 3627*, MA 3631, MA 4213, MA 4214, MA 46-- **

Item #	Title	Units
MA 3627	Introduction to the Design and Analysis of Experiments	1/3
MA 3631	Mathematical Statistics	1/3
MA 4213	Loss Models I - Risk Theory	1/3
MA 4214	Loss Models II - Survival Models	1/3

Other Requirements

Additional Courses (2/3 Units): Any course or independent study (excludes AS, MS, PE)

Basic Science (2/3 Units): Any BB, CH, ES, GE, or PH courses

Item #	Title	Units
BB 1001	Introduction to Biology	1/3
BB 1002	Environmental Biology	1/3
BB 1003/BCB 1003	Exploring Bioinformatics and Computational Biology	1/3
BB 1025	Human Biology	1/3
BB 1035	Biotechnology	1/3
BB 1045	Biodiversity	1/3
BB 2002	Microbiology	1/3
BB 2003	Fundamentals of Microbiology	1/3
BB 2030	Plant Diversity	1/3
BB 2040	Principles of Ecology	1/3
BB 2050	Animal Behavior	1/3
BB 2550	Cell Biology	1/3
BB 2902	Enzymes, Proteins, and Purification	1/6
BB 2903	Anatomy and Physiology	1/6
BB 2904	Ecology, Environment, and Animal Behavior	1/6
BB 2915	Searching for Solutions in Soil: Microbial and Molecular Investigations	1/3
BB 2917	Hunting for Phage	1/3
BB 2920	Genetics	1/3
BB 2950	Molecular Biology	1/3
BB 3003	Medical Microbiology: Plagues of the Modern World, a Case Study Approach	1/3
BB 3010/BCB 3010	Simulation in Biology	1/3
BB 3050	Cancer Biology	1/3
BB 3080	Neurobiology	1/3
BB 3101	Human Anatomy & Physiology: Movement and Communication	1/3
BB 3102	Human Anatomy & Physiology: Transport and Maintenance	1/3
BB 3120	Plant Physiology	1/3
BB 3140	Evolution: Pattern and Process	1/3
BB 3512	Molecular Genetics Lab	1/6
BB 3513	Cell Culture Techniques for Animal Cells	1/6
BB 3515	Physiologic Systems Laboratory	1/3
BB 3517	Fermentation	1/6
BB 3519	Protein Purification	1/6
BB 3521	Microscopy	1/6
BB 3525	Plant Physiology	1/6
BB 3526	Phage Hunters: the Analysis	1/6
BB 3527	Molecular Biology and Genetic Engineering: Approaches and Applications	1/3
BB 3530	Immunotherapies: The Next Generation of Pharmaceuticals	1/3
BB 3570	Cell Culture Models for Tissue Regeneration	1/3
BB 3620	Developmental Biology	1/3
BB 3920	Immunology	1/3
BB 4150	Environmental Change: Problems and Approaches	1/3
BB 4170/CH 4170	Experimental Genetic Engineering	1/3
BB 4190/CH 4190	Regulation of Gene Expression	1/3
BB 4260	Synthetic Biology	1/3
BB 4801/BCB 4001	Bioinformatics	1/3
BB 4900	Capstone Experience in Biology and Biotechnology	1/3
CH 1010	Chemical Properties, Bonding, and Forces	1/3
CH 1020	Chemical Reactions	1/3
CH 1030	Kinetics, Equilibrium and Thermodynamics	1/3
CH 1040	Spectroscopy in Organic and Polymer Chemistry	1/3
CH 2310	Organic Chemistry I	1/3

CH 2320	Organic Chemistry II	1/3
CH 2330	Organic Chemistry III	1/3
CH 2360	Organic Laboratory	1/3
CH 2640	Experimental Chemistry I: Instrumental Analysis	1/3
CH 2650	Modern Physical Chemistry Methods	1/3
CH 2660	Organic Synthesis and Analysis Laboratory	1/3
CH 2670	Investigation of Coordination Complexes Through Inquiry	1/3
CH 3310	Advanced Organic Chemistry	1/3
CH 3410	Structure, Bonding, and Reactivity in Inorganic Chemistry	1/3
CH 3510	Chemical Thermodynamics	1/3
CH 3530	Quantum Chemistry	1/3
CH 3550	Chemical Dynamics	1/3
CH 4110	Protein Structure and Function	1/3
CH 4120	Lipids and Biomembrane Functions	1/3
CH 4130	Nucleic Acids and Bioinformation	1/3
CH 4140	Metabolism and Disease	1/3
CH 4150	Enzymology and Protein Characterization Laboratory	1/3
CH 4160	Membrane Biophysics	1/3
CH 4330	Organic Synthesis	1/3
CH 4420	Principles and Applications of Group Theory in Chemistry	1/3
CH 4520	Chemical Statistical Mechanics	1/3
ES 1020	Introduction to Engineering	1/3
ES 1310	Introduction to Computer Aided Design	1/3
ES 1500	Fundamentals of Systems Thinking	1/3
ES 2001	Introduction to Materials Science	1/3
ES 2501	Introduction to Static Systems	1/3
ES 2502	Stress Analysis	1/3
ES 2503	Introduction to Dynamic Systems	1/3
ES 2800	Environmental Impacts of Engineering Decisions	1/3
ES 3001	Introduction to Thermodynamics	1/3
ES 3002	Mass Transfer	1/3
ES 3003	Heat Transfer	1/3
ES 3004	Fluid Mechanics	1/3
ES 3011	Control Engineering I	1/3
ES 3323	Advanced Computer Aided Design	1/3
ES 3501	A Project-Based Introduction to Systems Engineering	1/3
PH 1110	General Physics—Mechanics	1/3
PH 1111	Principles of Physics—Mechanics	1/3
PH 1120	General Physics—Electricity and Magnetism	1/3
PH 1121	Principles of Physics—Electricity and Magnetism	1/3
PH 1130	Modern Physics	1/3
PH 1140	Oscillations and Waves	1/3
PH 1150	Introductory Physics of Living Systems	1/3
PH 2101	Principles of Thermodynamics	1/3
PH 2201	Intermediate Mechanics I	1/3
PH 2202	Intermediate Mechanics II	1/3
PH 2301	Electromagnetic Fields	1/3
PH 2501	Photonics	1/3
PH 2502	Lasers	1/3
PH 2510	Atomic Force Microscopy	1/3
PH 2520	Introduction to Astrophysics	1/3
PH 2540	Solar Systems	1/3
PH 2550/AE 2550	Atmospheric and Space Environments	1/3
PH 2601	Photonics Laboratory	1/3
PH 2651	Intermediate Physics Laboratory	1/3
PH 3206	Statistical Physics	1/3

PH 3301	Electromagnetic Theory	1/3
PH 3401	Quantum Mechanics I	1/3
PH 3402	Quantum Mechanics II	1/3
PH 3501	Relativity	1/3
PH 3502	Solid State Physics	1/3
PH 3503	Nuclear Physics	1/3
PH 3504	Optics	1/3
PH 4201/PH 511	Advanced Classical Mechanics	1/3

Computer or Data Science (2/3 Units): Any CS or DS courses. Can only include one of DS 1010, CS 2022, and CS 3403

Item #	Title	Units
BCB 4002/CS 4802	Biovisualization	1/3
BCB 4003/CS 4803	Biological and Biomedical Database Mining	1/3
CS 1004	Introduction to Programming for Non-Majors	1/3
CS 1101	Introduction to Program Design	1/3
CS 1102	Accelerated Introduction to Program Design	1/3
CS 2011	Introduction to Machine Organization and Assembly Language	1/3
CS 2022/MA 2201	Discrete Mathematics	1/3
CS 2102	Object-Oriented Design Concepts	1/3
CS 2103	Accelerated Object-Oriented Design Concepts	1/3
CS 2119	Application Building with Object-Oriented Concepts	1/3
CS 2223	Algorithms	1/3
CS 2301	Systems Programming for Non-Majors	1/3
CS 2303	Systems Programming Concepts	1/3
CS 3013	Operating Systems	1/3
CS 3041	Human-Computer Interaction	1/3
CS 3043	Social Implications of Information Processing	1/3
CS 3133	Foundations of Computer Science	1/3
CS 3431	Database Systems I	1/3
CS 3516	Computer Networks	1/3
CS 3733	Software Engineering	1/3
CS 4032/MA 3257	Numerical Methods for Linear and Nonlinear Systems	1/3
CS 4033/MA 3457	Numerical Methods for Calculus and Differential Equations	1/3
CS 4099	Special Topics in Computer Science	1/3
CS 4100/IMGD 4100	Artificial Intelligence for Interactive Media and Games	1/3
CS 4120	Analysis of Algorithms	1/3
CS 4123	Theory of Computation	1/3
CS 4233	Object-Oriented Analysis and Design	1/3
CS 4241	Webware: Computational Technology for Network Information Systems	1/3
CS 4300/IMGD 4300	Graphics, Simulation, and Aesthetics	1/3
CS 4341	Introduction to Artificial Intelligence	1/3
CS 4342	Machine Learning	1/3
CS 4401	Software Security Engineering	1/3
CS 4404	Tools and Techniques in Computer Network Security	1/3
CS 4432	Database Systems II	1/3
CS 4433/DS 4433	Big Data Management and Analytics	1/3
CS 4445	Data Mining and Knowledge Discovery in Databases	1/3
CS 4513	Distributed Computing Systems	1/3
CS 4515	Computer Architecture	1/3
CS 4516	Advanced Computer Networks	1/3
CS 4518	Mobile and Ubiquitous Computing	1/3
CS 4533	Techniques of Programming Language Translation	1/3
CS 4536	Programming Languages	1/3
CS 4731	Computer Graphics	1/3
CS 4732	Computer Animation	1/3
CS 4801/ECE 4802	Introduction to Cryptography and Communication Security	1/3
CS 4804	Data Visualization	1/3
DS 1010	Data Science I: Introduction to Data Science	1/3
DS 2010	Data Science II: Modeling and Data Analysis	1/3
DS 3010	Data Science III: Computational Data Intelligence	1/3
DS 4635/MA 4635	Data Analytics and Statistical Learning	1/3
MA 3457/CS 4033	Numerical Methods for Calculus and Differential Equations	1/3

Related Courses (2/3 Units): Any courses from science, engineering, computer science, data science, business (except FIN 1250)

[†] MA 1801 is 1/12 unit and can be taken four times to be equivalent to a 1/3 unit course; [‡‡] WPI credit can only be received for either MA 2071 or MA 2072 and either MA 2621 or MA 2631; * Category II Courses, offered in alternating years; ** All 46-- courses are topics in Statistics; Note that each class, including cross-listed classes (e.g. MA 2201/CS 2202), may only count towards one distribution requirement.

Program Chart and/or Course Flow Chart

MATHEMATICAL SCIENCES MAJOR PROGRAM CHART

UNIVERSITY REQUIREMENTS	
Minimum Academic Credit	15 units
Residency	8 units
Free Electives	3/3 units
Humanities and Arts	6/3 units
Interactive Qualifying Project	3/3 units
Major Qualifying Project	3/3 units
Social Science	2/3 units
Physical Education	1/3 units

FOUNDATION COURSES

INTRODUCTORY COURSES (8/3 Units Required)	TRANSITION COURSES (4/3 Units Required)	CORE COURSES (1/3 Units Required)	UPPER-LEVEL COURSES (3/3 Units Required)
Any MA courses. Suggestions: MA 1021 – 1024 or MA 1033 – 1034, MA 1801[†], MA 1971, MA 2051, MA 2071[‡] or MA 2072[‡], MA 2201, MA 2210, MA 2211, MA 2212, MA 2611, MA 2612, MA 2621[‡‡] or MA 2631[‡‡]	One of MA 1033 or MA 1971, MA 2073, MA 2211, MA 2251, MA 2271*, MA 2273*, MA 2431, MA 2631[‡‡], MA 3631	Analysis: MA 3831 and MA 3832 Computation: MA 3257 or MA 3457 Algebra: MA 3823 or MA 3825*	Any 3000-level or higher courses, including experimental and special topics courses

UPPER-LEVEL COURSES

ACTUARIAL MATH	ANALYSIS	ALGEBRA/ DISCRETE	COMPUTATIONAL MATH	OPERATIONS RESEARCH	STATISTICS/ PROBABILITY
MA 3212 MA 4213 MA 4214 MA 4892	MA 3471* MA 3475* MA 4291 MA 4451 MA 4473* MA 4895*	MA 3233* MA 3823 MA 3825*	MA 3257 MA 3457 MA 4411* MA 4222*	MA 3231 MA 3233* MA 4235* MA 4237*	MA 3627* MA 3631 MA 4213 MA 4214 MA 46-- **

OTHER REQUIREMENTS

ADDITIONAL COURSES (2/3 Units Required)	BASIC SCIENCE (2/3 Units Required)	COMPUTER or DATA SCIENCE (2/3 Units Required)	RELATED COURSES (2/3 Units Required)
Any course or independent study (excludes AS, MS, PE)	Any BB, CH, ES, GE, or PH courses	Any CS or DS courses. Can only include one of DS 1010, CS 2022, and CS 3403	Any courses from science, engineering, computer science, data science, business (except FIN 1250)

[†] MA 1801 is 1/12 unit and can be taken four times to be equivalent to a 1/3 unit course; [‡‡] WPI credit can only be received for either MA 2071 or MA 2072 and either MA 2621 or MA 2631; * Category II Courses, offered in alternating years; ** All 46-- courses are topics in Statistics; Note that each class, including cross-listed classes (e.g. MA 2201/CS 2202), may only count towards one distribution requirement.

Mathematics Minor

Degree Type

Minor

The Minor in Mathematics consists of the successful completion of at least 2 units of academic activities in mathematical sciences.

Students should discuss course selections for the minor in advance with a member of the mathematical sciences faculty who will serve as the Minor Advisor. The student must complete the Mathematics Minor Program Planning and Approval Form and have it signed by the Minor Advisor. Students are encouraged to do this as early as possible, but it must be done prior to starting the Capstone.

For more information about the Mathematics minor, see Professor Tripp, who is the coordinator for Mathematics minors.

The following requirements must be satisfied.

At least 5/3 units of coursework in the Mathematical Sciences Department at the 2000 level or above[1]

2000-Level Mathematical Sciences (MA) Courses[2]

Item #	Title	Units
CS 2022/MA 2201	Discrete Mathematics	1/3
MA 2051	Ordinary Differential Equations	1/3
MA 2071	Matrices and Linear Algebra I	1/3
MA 2072	Accelerated Matrices and Linear Algebra I	1/3
MA 2073	Matrices and Linear Algebra II	1/3
MA 2210	Mathematical Methods in Decision Making	1/3
MA 2211	Theory of Interest I	1/3
MA 2212	Theory of Interest II	1/3
MA 2251	Vector and Tensor Calculus	1/3
MA 2271	Graph Theory	1/3
MA 2273	Combinatorics	1/3
MA 2431	Mathematical Modeling with Ordinary Differential Equations	1/3
MA 2610	Applied Statistics for the Life Sciences	1/3
MA 2611	Applied Statistics I	1/3
MA 2612	Applied Statistics II	1/3
MA 2621	Probability for Applications	1/3
MA 2631	Probability Theory	1/3

3000-Level Mathematical Sciences (MA) Courses

Item #	Title	Units
CS 4032/MA 3257	Numerical Methods for Linear and Nonlinear Systems	1/3
CS 4033/MA 3457	Numerical Methods for Calculus and Differential Equations	1/3
MA 3212	Actuarial Mathematics I	1/3
MA 3213	Actuarial Mathematics II	1/3
MA 3231	Linear Programming	1/3
MA 3233	Discrete Optimization	1/3
MA 3457/CS 4033	Numerical Methods for Calculus and Differential Equations	1/3
MA 3471	Advanced Ordinary Differential Equations	1/3
MA 3475	Calculus of Variations	1/3
MA 3627	Introduction to the Design and Analysis of Experiments	1/3
MA 3631	Mathematical Statistics	1/3
MA 3823	Group Theory	1/3
MA 3825	Rings and Fields	1/3
MA 3831	Principles of Real Analysis I	1/3
MA 3832	Principles of Real Analysis II	1/3

4000-Level Mathematical Sciences (MA) Courses

Item #	Title	Units
BCB 4004/MA 4603	Statistical Methods in Genetics and Bioinformatics	1/3
DS 4635/MA 4635	Data Analytics and Statistical Learning	1/3
MA 4213	Loss Models I - Risk Theory	1/3
MA 4214	Loss Models II - Survival Models	1/3
MA 4216	Actuarial Seminar	
MA 4222	Top Algorithms in Applied Mathematics	1/3
MA 4235	Mathematical Optimization	1/3
MA 4237	Probabilistic Methods in Operations Research	1/3
MA 4291	Applied Complex Variables	1/3
MA 4411	Numerical Analysis of Differential Equations	1/3
MA 4451	Boundary Value Problems	1/3
MA 4473	Partial Differential Equations	1/3
MA 4631	Probability and Mathematical Statistics I	1/3
MA 4632	Probability and Mathematical Statistics II	1/3
MA 4891	Topics in Mathematics	1/3
MA 4892	Topics in Actuarial Mathematics	1/3
MA 4895	Differential Geometry	1/3

Graduate-Level Mathematical Sciences (MA) Courses

Item #	Title	Units
	See Graduate Catalog for Grad Course Listings	

1/3 unit Capstone Experience

The experience may be satisfied by certain 3000-level, 4000-level or graduate courses offered by the department or by a suitable independent study with a Mathematical Sciences faculty member. The Capstone must be approved in advance by having the Capstone instructor sign the Mathematics Minor Planning and Approval Form. After completion of the Capstone Experience, the Mathematics Minor Program Planning and Approval Form is submitted to the Mathematical Sciences Program Review Chair for final approval.

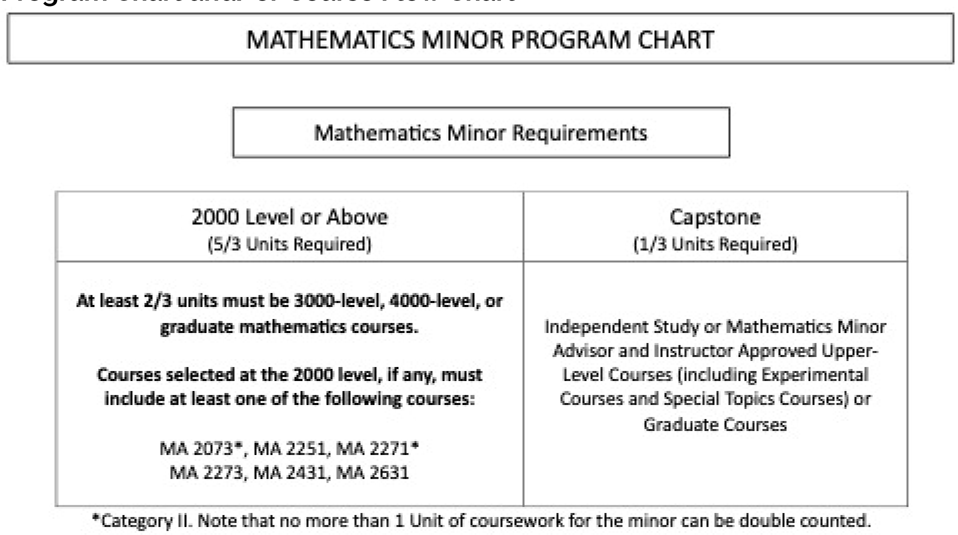
Notes:

[1]At least 2/3 units must be upper-level courses, i.e. 3000-level, 4000-level, or graduate mathematics courses.

[2]Courses selected at the 2000 level, if any, must include at least one of the following courses:

Item #	Title	Units
MA 2073	Matrices and Linear Algebra II	1/3
MA 2251	Vector and Tensor Calculus	1/3
MA 2271	Graph Theory	1/3
MA 2273	Combinatorics	1/3
MA 2431	Mathematical Modeling with Ordinary Differential Equations	1/3
MA 2631	Probability Theory	1/3

Program Chart and/or Course Flow Chart



Statistics Minor

Degree Type

Minor

Statistical methods are widely used in science, engineering, business, and industry. The Statistics Minor is appropriate for all WPI students with interests in experimental design, data analysis, or statistical modeling. The minor is designed to enable a student to properly design studies and analyze the resulting data, and to evaluate statistical methods used in their field of study. Students should discuss course selections for the minor in advance with a statistics faculty member, who serves as the Minor Advisor. The student must complete the Statistics Minor Program Planning and Approval Form, and have it signed by the Minor Advisor. Students are encouraged to do this as early as possible, but it must be done prior to starting the Capstone. The statistics minor consists of completion of at least 2 units of work. For information about the Statistics Minor, see Professor Carly Thorp, who is the coordinator for the Statistics Minor.

At least 5/3 units of coursework drawn from the following lists of Foundation and Upper-Level Courses

Must include successful completion of at least 2/3 units from each list:

Foundation Courses

MA 2621 OR MA 2631 may be used as a foundation course. Both cannot be used as the 2/3 units of foundation course requirement. Students may not earn University credit for both MA 2621 and MA 2631.

Item #	Title	Units
MA 2073	Matrices and Linear Algebra II	1/3
MA 2611	Applied Statistics I	1/3
MA 2612	Applied Statistics II	1/3
MA 2621	Probability for Applications	1/3
MA 2631	Probability Theory	1/3

Upper-Level Courses

Item #	Title	Units
BCB 4004/MA 4603	Statistical Methods in Genetics and Bioinformatics	1/3
DS 4635/MA 4635	Data Analytics and Statistical Learning	1/3
MA 3627	Introduction to the Design and Analysis of Experiments	1/3
MA 3631	Mathematical Statistics	1/3
MA 4213	Loss Models I - Risk Theory	1/3
MA 4214	Loss Models II - Survival Models	1/3
MA 4237	Probabilistic Methods in Operations Research	1/3
MA 4631	Probability and Mathematical Statistics I	1/3
MA 4632	Probability and Mathematical Statistics II	1/3

Statistics graduate courses MA 509 or any course numbered MA 540 through MA 559

Item #	Title	Units
	See Graduate Catalog for Grad Course Listings	

1/3 unit Capstone Experience

The capstone experience may be satisfied by certain 3000-level, 4000-level or graduate courses offered by the department or by a suitable independent study with one of the department's statistics faculty. The Capstone must be approved in advance by having the Capstone instructor sign the Statistics Minor Program Approval Form. After completion of the Capstone Experience, the Statistics Minor Program Planning and Approval Form is submitted to Statistics Minor Advisor for final approval.

Program Chart and/or Course Flow Chart

STATISTICS MINOR PROGRAM CHART

Statistics Minor Requirements – 2 Units

Foundation Courses (2/3 Units Minimum Required)	Upper-Level Courses (2/3 Units Minimum Required)	Capstone (1/3 Units Required)
MA 2073 MA 2611 MA 2612 MA 2621 **OR** MA 2631	MA 3627* MA 3631 MA 4213 MA 4214 MA 4237* MA 4603* MA 4631/4632** MA 4635 MA 540 – MA 559** MA 584**	Independent Study or Statistics Minor Advisor and Instructor Approved Upper-Level Courses (including Experimental Courses and Special Topics Courses) or Graduate Courses

*Category II, ** 14-weeks. Note that no more than 1 Unit of coursework for the minor can be double counted.

Physics

D. T. PETKIE, HEAD; D. C. MEDICH, ASSOCIATE HEAD

PROFESSORS: P. K. Aravind, N. A. Burnham, G. S. Iannacchione, D. C. Medich, D. T. Petkie, L. R. Ram-Mohan, S. A. Zekavat, A. A. Zozulya

ASSOCIATE PROFESSORS: R. S. Quimby, L.V. Titora, Q. Wen, K. Wu

ASSISTANT PROFESSORS: W.C. McCarthy, R. Trubko

ASSOCIATE PROFESSORS OF TEACHING: R. Kafle, I. Stroe

ASSOCIATE TEACHING PROFESSOR: H. Kashuri

ASSISTANT TEACHING PROFESSORS: S. Kadam, B. Pollard

ASSISTANT RESEARCH PROFESSOR: K. Friedman

INSTRUCTOR OF PHYSICS: T. P. Noviello

ASSOCIATED FACULTY: F. Bernardi (MA), N.A. Deskins (CHE), C. Furlong (ME), D. Lados (ME), B. Tilley (MA), Y. Liu (ME)

Mission Statement

The Physics Department provides education in physics to both undergraduate and graduate students and contributes to the growth of human knowledge through scholarly work.

Program Educational Objectives

The physics department educates students with a program characterized by curricular flexibility, student project work, and active involvement of students in their learning. Through a balanced, integrated curriculum stressing the widely applicable skills and knowledge of physics, we provide an education that is strong both in fundamentals and in applied knowledge, appropriate for immediate use in a variety of fields as well as graduate study and lifelong learning.

Program Outcomes

We expect that physics graduates:

1. Know, understand, and use a broad range of basic physical principles.
2. Have an understanding of appropriate mathematical methods, and an ability to apply them to physics.
3. Have demonstrated oral and written communications skills.
4. Can find, read, and critically evaluate selected original scientific literature.
5. Have an ability to learn independently.
6. Understand options for careers and further education, and have the necessary educational preparation to pursue those options.
7. Have acquired the broad education envisioned by the WPI Plan.
8. Are prepared for entry level careers in a variety of fields, and are aware of the technical, professional, and ethical components.
9. Are prepared for graduate study in physics and/or other fields.

The Department of Physics at WPI offers:

1. the Bachelor of Science degree in Physics;

2. the Bachelor of Science degree in Applied Physics;
3. a Minor in Physics;
4. a Minor in Astrophysics

The second digit in physics course numbers is coded as follows .

1 — General physics
2 — Theoretical mechanics, statistical physics, kinetic theory, etc . 3 — Electricity and magnetism, electromagnetic theory
4 — Quantum mechanics
5 — Particular topics
6 — Laboratory

INTRODUCTORY PHYSICS SEQUENCE

There are four course topics in the introductory physics sequence . The four topics are Classical Mechanics (PH 1110/PH 1111), Electricity and Magnetism (PH 1120/PH 1121), Modern Physics (PH 1130), and Oscillations and Waves (PH 1140) . Each course includes a laboratory component .

Students should take either PH 1110 or PH 1111, but not both; similarly, either PH 1120 or PH 1121, but not both . The primary difference between the PH 1110-PH 1120 option and PH 1111-PH 1121 is that the material in PH 1111- PH 1121 is treated somewhat more formally and rigorously than in PH 1110-PH 1120, thus presuming a better-than-average mathematics background . The recommended mathematics background for each course is indicated in the respective course description and should be considered carefully in each case .

Because the topics covered in the two mechanics and in the two electricity and magnetism courses are the same, it is possible to cross over from one sequence to the other . For example, PH 1120 could be taken after PH 1111, or, upon consulting with the course instructor, PH 1121 could be taken after successful completion of PH 1110 . Finally, it should be noted that any combination of the first two introductory courses provides adequate preparation for both of the remaining courses in Modern Physics (PH 1130), and Oscillations and Waves (PH 1140) .

The courses in classical mechanics and electricity and magnetism are regarded as essential preparation for many fundamental engineering courses as well as for further work in physics . PH 1130 gives a first introduction to modern physics and is designed to provide a context for the appreciation of present-day advances in physics and high-technology applications . PH 1140 deals in depth with oscillating systems, a topic area of fundamental importance in physics, and whose engineering applications span the range from electromagnetic oscillations to the mechanical vibrations of machinery and structures.

PHYSICS AND APPLIED PHYSICS PROGRAMS ADVISING

Because the normal period of residency at WPI is 16 terms (fours terms for four years), there is a potential for 16 units total while the minimum graduation requirement is 15 units. The difference is a WPI-wide 1 unit (3 courses) of free-electives. The general WPI requirements of 4-units must include the Humanities and Arts requirement (2 units), the Interactive Qualifying Project – IQP (1 unit), the Social Sciences (2/3 unit), and Physical Education (1/3 unit). For PH and PHA students a minimum of 10 units in the program is required leaving an additional 1-unit of physics-electives. Thus, a great deal of flexibility exists to custom craft the curriculum.

For a student entering the study of physics, there is a natural progression of subjects which provide a foundation for advanced work within physics and applied physics programs. This constitutes a core sequence which embodies the following indispensable basic areas of study: classical mechanics, electro- magnetism, a survey of modern physics, statistical and quantum physics, and laboratory experimental methods. Because the language of the exact sciences is mathematics, there is a parallel core sequence of mathematics courses normally taken either as preparation for or concurrently with the physics courses with which they are paired in the list presented below. In the following table → indicates that the mathematics course is strongly recommended; ↔ indicates that concurrent study is acceptable.

MA 1021 Calculus I	↔	PH 1110 Mechanics

MA 1022 Calculus II	↔	PH 1120 Electricity and Magnetism
MA 1023 Calculus III	↔	PH 1111 Mechanics
MA 1024 Calculus IV	↔	PH 1121 Electricity and Magnetism
MA 1023 Calculus III	↔	PH 1130 Modern Physics
MA 1024 Calculus IV	↔	PH 1140 Oscillations and Waves
MA 2051 Differential Equations	↔	PH 2202 Intermediate Mechanics II
MA 2071 Linear Algebra	→	PH 2651 Physics Laboratory
MA 2251 Vector/Tensor Calculus	→	PH 2301 Electromagnetic Fields I
MA 4451 Boundary Value Problems	↔ →	PH 3301 Electromagnetic Theory PH 3206 Statistical Physics PH 3401 Quantum Mechanics I

Physics and applied physics students should also reserve part of their undergraduate experience for developing perspective in a range of other science and engineering disciplines. A few of the many possibilities are illustrated by the following examples.

- Chemistry (CH 1010, 1030); Material Science (ES 2001). Choosing appropriate materials is often crucial in the development of new experimental techniques that can further our knowledge of physical phenomena. Conversely, the studies of physicists have had profound effects on the development of new materials.
- Electronics, both analog (ECE 2201 and 3204, and digital (ECE 2022). Electronics pervades the modern laboratory. It is valuable to learn electronic principles and designs as they are applied in modern "on-line" experimental data collection and data reduction systems.
- Computer science (CS 1101 or CS 1102 and CS 2301). Physics students will need to make skillful use of computers in present and future experimental data processing, theoretical analyses, and the storing, retrieving and displaying of scientific information.
- Engineering courses related to science. Some basic knowledge in areas such as heat transfer, control systems, fluid mechanics, stress analysis and similar topics will prove to be of great benefit to the physicist called upon to apply professional knowledge to practical engineering problems.
- Join Teacher Preparation Program and be armed with leading-edge educator skills and a mastery physics to become a new kind of teacher --a teacher who engages and challenges students and makes a difference by educating the next generation of STEM leaders. See the Teacher Preparation program or visit www.wpi.edu/+teach.

Building on this core and topical subject coverage, physics students are in a position to turn in any number of directions within the range of physics studies, depending on individual interests and career objectives. Six illustrative examples are outlined below. In each case the outline includes a list of recommended and related courses followed by a sampling of project opportunities in the respective areas. Selection of specific courses and projects should be determined by students' interests and the guidance of their academic advisors and the engineering-physics coordinator. For courses outside of the physics department, students are advised to discuss the prerequisites with the instructor.

Recommended and Related Courses Outline

Applied Physics Major

Degree Type

Bachelor of Science

The applied physics option is available to students who wish to obtain an interdisciplinary education based in physics. It is the goal of this program to either enable students to develop their own interdisciplinary course of study or to pursue current interdisciplinary areas such as: biophysics, nuclear science and engineering, medical physics, optics, engineering physics, or chemical physics.

Program Distribution Requirements for the Applied Physics Major

Mathematics (Minimum 9/3 Units)

Courses must include a course in Calculus, Differential Equations, Vector Calculus, Boundary Value Problems, and may include applied mathematical courses in physics, chemistry, biology, or computer science.

Physics (Minimum 15/3 Units)

Students must take at least one course from each of the following physics core areas:

Mechanics

Item #	Title	Units
PH 2201	Intermediate Mechanics I	1/3
PH 2202	Intermediate Mechanics II	1/3
PH 4201/PH 511	Advanced Classical Mechanics	1/3

Electromagnetism

Item #	Title	Units
PH 2301	Electromagnetic Fields	1/3
PH 3301	Electromagnetic Theory	1/3

The graduate courses below may also be used to satisfy the Electromagnetism Requirement.

ITEM #	TITLE	UNITS
PH 533	ADVANCED ELECTROMAGNETIC THEORY	1/3

Quantum Mechanics

Item #	Title	Units
PH 3401	Quantum Mechanics I	1/3
PH 3402	Quantum Mechanics II	1/3

The graduate courses below may also be used to satisfy the Quantum Mechanics Requirement.

ITEM #	TITLE	UNITS
PH 514	QUANTUM MECHANICS I	1/3
PH 515	QUANTUM MECHANICS II	1/3

Thermodynamics and Statistical Mechanics

Item #	Title	Units
CH 3510	Chemical Thermodynamics	1/3
PH 2101	Principles of Thermodynamics	1/3
PH 3206	Statistical Physics	1/3

The graduate courses below may also be used to satisfy the Thermodynamics and Statistical Mechanics Requirement.

ITEM #	TITLE	UNITS
PH 522	THERMODYNAMICS AND STATISTICAL MECHANICS	1/3

Experimental Techniques or Laboratory

Item #	Title	Units
PH 2601	Photonics Laboratory	1/3
PH 2651	Intermediate Physics Laboratory	1/3

To satisfy this requirement, a student must take and pass with a grade of C or better at least 1/3 unit from each of the core physics areas: Mechanics, Electromagnetism, Quantum Mechanics, Thermodynamics and Statistical Mechanics, and Experimental Techniques or Laboratory. An MQP (1 unit) is required. Physics 1110/1111, 1120/1121, 1130, and 1140 may be counted toward the 5 unit physics requirement. An MQP with substantial experimental activity, if approved in advance by the Physics Department Undergraduate Curriculum Committee, may substitute 1/3 units of an MQP in place of the Experimental Techniques / Laboratory course

Applied Focus (Minimum 6/3 Units)

The Applied Focus requirement is satisfied by completing a minor in a department other than physics or by completing a coherent group of at least two units of courses in an applied field. The 2 unit program must be formulated prior to the student's final year of study by the student in consultation with his/her academic advisor and approved by the Physics Department Undergraduate Curriculum Committee.

GENERAL NOTE: Other courses or ISUs may satisfy one or more of these requirements upon prior approval by the Physics Undergraduate Curriculum Committee. For course substitutions, the student must submit a petition with a substitution proposal prior to the taking the course and the course instructor must provide a statement of support that the course will meet the qualifications of the substituted course.

Physics Major

Degree Type

Bachelor of Science

Program Distribution Requirements for the Physics Bachelor of Science

The normal period of residency at WPI is 16 terms. In addition to the WPI requirements applicable to all students (see page 7) of 4 units, completion of a minimum of 10 units of study is required for physics and applied physics in the areas of mathematics, physics, and related fields as follows:

Mathematics (Minimum 9/3 Units)

Mathematics must include at least 2/3 unit of mathematics at the level of MA 3000 or higher.

Item #	Title	Units
CS 4032/MA 3257	Numerical Methods for Linear and Nonlinear Systems	1/3
CS 4033/MA 3457	Numerical Methods for Calculus and Differential Equations	1/3
MA 3213	Actuarial Mathematics II	1/3
MA 3457/CS 4033	Numerical Methods for Calculus and Differential Equations	1/3
MA 3627	Introduction to the Design and Analysis of Experiments	1/3
MA 3631	Mathematical Statistics	1/3

Physics (including the MQP) (Minimum 15/3 Units)

Either item 2 or 3 must include at least 1/3 unit from each of the five principal areas of physics: mechanics, experimental physics, electromagnetism, quantum mechanics, and thermal/statistical physics. This core distribution requirement is satisfied by successfully completing at least one course from each of the following five areas:

Mechanics (PH 2201 or 2202)

Item #	Title	Units
PH 2201	Intermediate Mechanics I	1/3
PH 2202	Intermediate Mechanics II	1/3

Electromagnetism (PH 2301 or PH 3301)

Item #	Title	Units
PH 2301	Electromagnetic Fields	1/3
PH 3301	Electromagnetic Theory	1/3

Experimental Physics (PH 2651 or 2601)

Item #	Title	Units
PH 2601	Photonics Laboratory	1/3
PH 2651	Intermediate Physics Laboratory	1/3

Quantum Mechanics (PH 3401 or PH 3402)

Item #	Title	Units
PH 3401	Quantum Mechanics I	1/3
PH 3402	Quantum Mechanics II	1/3

Thermal/Statistical Physics (CH 3510, ES 3001, CH 3510, PH 2101 or PH 3206)

Item #	Title	Units
CH 3510	Chemical Thermodynamics	1/3
ES 3001	Introduction to Thermodynamics	1/3
PH 2101	Principles of Thermodynamics	1/3
PH 3206	Statistical Physics	1/3

Other courses or ISUs may satisfy one or more of these areas but must be approved by the department Undergraduate Curriculum Committee. For substitutions, the student must submit a petition with a substitution proposal prior to the activity and the activity outcome must be approved by a physics faculty who has taught in the particular area.

ES 3001 and CH 3510 count as physics courses

Other subjects to be selected from mathematics, science, engineering, computer science, and business (Minimum 9/3 Units)

Either the Physics or Other Subjects requirement must include at least 1/3 unit from each of the five principal areas of physics: mechanics, experimental physics, electromagnetism, quantum mechanics, and thermal/statistical physics. This core distribution requirement is satisfied by successfully completing at least one course from each of the following five areas: Mechanics (PH 2201 or 2202); Experimental Physics (PH 2651 or 2601); Electromagnetism (PH 2301 or PH 3301); Quantum Mechanics (PH 3401 or 3402); and Thermal/Statistical Physics (ES 3001, CH3510, PH 2101, or PH 3206). Other courses or ISUs may satisfy one or more of these areas but must be approved by the department Undergraduate Curriculum Committee. For substitutions, the student must submit a petition with a substitution proposal prior to the activity and the activity outcome must be approved by a physics faculty who has taught in the particular area.

Astrophysics Minor

Degree Type
Minor

For students of the sciences interested in the stars and seeking to acquire a minor expertise with a cosmic perspective, the Physics Department offers a Minor in Astrophysics. Candidates for the Minor complete two units of work, with one unit of Astrophysics courses, and one unit of recommended background courses consisting of: 1/3 unit of mechanics, 1/3 unit of electromagnetism and 1/3 unit of quantum mechanics.

Candidates also complete an Astrophysics Minor Project either as part of one of the astrophysics courses or as a separate ISU. The project consists of: a) selecting an astrophysical topic of interest, b) posing a relevant question and performing in-depth analysis and investigation, and c) writing a paper, all in consultation with the instructor advising the project.

Students majoring in Physics or in Applied Physics may not do a Minor in Astrophysics.

Students complete the “Application for a Minor in Astrophysics” and present it to the Head of the Physics Department. The Application is available in the Physics Department Office. The Head of the Physics Department will be responsible for the review and approval of all requests for the Minor. WPI policy requires that no more than one unit of course work be double counted toward other degree requirements.

Astrophysics Courses:

Item #	Title	Units
PH 2520	Introduction to Astrophysics	1/3
PH 2540	Solar Systems	1/3
PH 2550/AE 2550	Atmospheric and Space Environments	1/3

Recommended Background Courses

Item #	Title	Units
	PH 1110/1111, PH 2201, PH 2202, PH 4201, or PH 511	1/3
	PH 1120/1121, PH 2301, PH 3301, or PH 533	1/3
	PH 1130, PH 3401, PH 3402, or PH 514	1/3

Nanoscience Minor

Degree Type
Minor

Important to nanoscience are the studies of the structure and function of molecules, and the quantum and atomic properties of matter. Nanoscientists investigate fundamental aspects of the behavior of molecules, materials, devices, and living matter at length scales smaller than the wavelength of visible light. Synthesizing knowledge across disciplines greatly enhances progress in understanding nanoscale systems. A Minor in Nanoscience will benefit students who wish to enhance their disciplinary major with an additional degree designation in the area of Nanoscience.

The Minor in Nanoscience requires the completion of at least two units of course work in the topical areas described below: Students planning the minor should contact Professor Burnham in the Physics Department.

Program Distribution Requirements for the Nanoscience Minor

Structure of Molecules (Minimum 1/3 Unit)

At least one course in organic, inorganic, or physical chemistry

Organic Chemistry Courses

Item #	Title	Units
BB 2920	Genetics	1/3
CH 2310	Organic Chemistry I	1/3
CH 2320	Organic Chemistry II	1/3
CH 2330	Organic Chemistry III	1/3
CH 2360	Organic Laboratory	1/3
CH 2660	Organic Synthesis and Analysis Laboratory	1/3
CH 3310	Advanced Organic Chemistry	1/3
CH 4330	Organic Synthesis	1/3
CH 536	Theory and Applications of NMR Spectroscopy	1/3
CH 538	Medicinal Chemistry	1/3

Inorganic Chemistry Courses

Physical Chemistry Courses

Function of Molecules (Minimum 1/3 Unit)

At least one course (1/3 unit) selected from the following list:

Function of Molecules Courses

Item #	Title	Units
BB 1035	Biotechnology	1/3
BB 2550	Cell Biology	1/3
BB 2920	Genetics	1/3

Atomic Properties of Matter (Minimum 1/3 Unit)

At least one course (1/3 unit) selected from the following list:

Atomic Properties of Matter Courses

Item #	Title	Units
ES 2001	Introduction to Materials Science	1/3
ME 4875/MTE 575	Introduction to Nanomaterials and Nanotechnology	1/3
PH 3502	Solid State Physics	1/3

Quantum Properties of Matter (Minimum 1/3 Unit)

At least one course (1/3 unit) selected from the following list:

Quantum Properties of Matter Courses

Item #	Title	Units
CH 3530	Quantum Chemistry	1/3
PH 1130	Modern Physics	1/3
PH 2501	Photonics	1/3
PH 2502	Lasers	1/3
PH 3401	Quantum Mechanics I	1/3
PH 3402	Quantum Mechanics II	1/3

Nanoscale Fabrication and Characterization

(No minimum number of required courses.)

Nanoscale Fabrication and Characterization Courses

Item #	Title	Units
PH 2510	Atomic Force Microscopy	1/3

Interdisciplinary Capstone Experience in Nanoscience (Minimum 1/3 Unit)

The capstone experience for the Nanoscience minor can be satisfied either by i) an independent study arranged for this purpose as the sixth course in the sequence, or ii) a small project during an existing course, also as the sixth course in the sequence.[C] If the second option is chosen, the student must arrange an interdisciplinary capstone experience with the instructor prior to the start of the course, and the instructor must agree to advise it. In either case, documentation of the capstone is required, prepared in consultation with the independent study advisor or instructor, which incorporates and ties together concepts learned in the Nanoscience courses selected. After successful completion of the capstone, the instructor shall notify the student, Professor Burnham in the Physics Department, and the Registrar.

Notes:

1. In keeping with Institute-wide policy for minors, up to three courses may be double-counted for degree requirements (at most 1/3 unit of IQP), no course may be triple-counted, and the capstone experience must be done at the end of the sequence. The Major Qualifying Project (MQP) may not be counted toward activity for Minors.
2. Other courses, including graduate courses, may be used to satisfy the four topic areas with the approval of the Nanoscience Minor Committee.
3. A list of faculty who are willing to advise Nanoscience Capstones or ISUs is given at the bottom of https://www.wpi.edu/academics/study/nanoscience-minor.

Physics Minor

Degree Type
Minor

The Physics Minor offers non-Physics majors the opportunity to broaden their understanding of both the principles of physics and the application of those principles to modern day engineering problems. In these times of rapid technological change, knowledge of fundamental principles is a key to adaptability in a changing workforce.

Two units of coordinated physics activity are required for the Physics Minor, as follows (note that, in accordance with Institute policy, no more than 3/3 of these units may be double-counted toward other degree requirements):

Any or all of the following four introductory courses:

Item #	Title	Units
	PH 1110 or PH 1111	
PH 1120	General Physics—Electricity and Magnetism	1/3
PH 1130	Modern Physics	1/3
PH 1140	Oscillations and Waves	1/3

At least 2/3 unit of upper level physics courses

Students who have taken the four course introductory sequence should have an adequate physics background for these courses; see, however, the individual course descriptions for the expected mathematical background. Other physics courses may be selected for the physics minor, but the recommended background for such courses often includes one or more of the courses listed above.

At least 2/3 unit of upper level physics courses (2000 level or higher), which may include ISU courses or independent studies approved by the program review committee. Examples of courses of this type which might be selected are (but are not limited to):

Item #	Title	Units
PH 2201	Intermediate Mechanics I	1/3
PH 2301	Electromagnetic Fields	1/3
PH 2651	Intermediate Physics Laboratory	1/3
PH 3401	Quantum Mechanics I	1/3
PH 3504	Optics	1/3
PH 2501	Photonics	1/3
ISU	Special Topics	1/3

Capstone Experience

The capstone experience for the physics minor can be satisfied either by an independent study project (ISU) arranged for this purpose, or by one of the upper level courses. IF the second option is chosen, the student must discuss this with the instructor prior to the start of the course. In either case, documentation of the capstone experience will consist of a paper, prepared in consultation with the instructor or independent study project advisor, which incorporates and ties together concepts learned in the physics courses selected.

For more information, or assistance in selecting a minor advisor or an independent study advisor, see the Head of the Physics Department in Olin Hall 119.

Majors in Physics or Applied Physics do not qualify for a Minor in Physics.

Psychological Science Program

FACULTY: J. K. Doyle, R. Lopez, E. Ottmar, A. C. Rodriguez, K. Schneider (Visiting), S. T. Shaw, J. Skorinko

Psychological Science Major

Degree Type
Bachelor of Science

J. Skorinko: Program Director

A. Rodriguez: Assistant Program Director

Psychology is the study of the entire range of human experience, thought, and behavior, from infancy until death, from the most abnormal behavior to the most mundane, from the behavior of neurons to the actions of societies and nations. Psychologists employ a wide variety of methods to understand behavior and to discover how best to improve performance, including controlled experiments on human subjects. WPI's major in psychological science emphasizes empirical research in the areas of social and cognitive psychology as well as practical applications to the classroom, the courtroom, and other settings.

PROGRAM OUTCOMES

In addition to fulfilling WPI's university-wide undergraduate learning outcomes, psychological science majors will demonstrate:

1. Familiarity with the major concepts, theoretical perspectives, empirical findings, and trends in psychology.
2. Understanding of and ability to apply basic research methods in psychology, including experimental design, data analysis, and interpretation.
3. Ability to apply psychological principles to personal, social, organizational, and societal issues, including developing insight into their own and others' behavioral and mental processes.
4. Understanding of the relationship and interactions between psychology and other social science domains.
5. Ability to understand the role of and apply knowledge of psychological phenomena in other domains, such as business, computer science, or biology.
6. Ability to recognize, understand, and respect the complexity of sociocultural and international diversity.
7. Understanding of the ethics of human subjects research and the ability to apply that understanding in designing research or practices that do not violate ethical guidelines.
8. Knowledge of basic science and how it contributes to understanding human behavior.

[Adapted from the American Psychological Association Report on Undergraduate Psychology Learning Goals and Outcomes.]

Program Distribution Requirements for the Psychological Science Major

The normal period of residency at WPI is 16 terms. In addition to the WPI requirements applicable to all students, completion of a minimum of 10 units of study is required in psychological science, social science, basic science, and mathematics as follows.

Psychological Science (Minimum 12/3 Units)

Must include introductory psychology, social psychology, cognitive psychology, and experimental design.

Psychological Science and/or Related Courses (Minimum 4/3 Units)

Related courses may be additional psychology courses, other social science courses (DEV, ECON, ENV, GOV, SD, SOC, STS), ID 2050, or they may be chosen from a list of psychology-related courses from other departments listed in the undergraduate catalog section for the Psychological Science major.

Examples of psychology-related courses from other departments

Item #	Title	Units
BB 2050	Animal Behavior	1/3
BB 2920	Genetics	1/3
BB 3080	Neurobiology	1/3
BB 3101	Human Anatomy & Physiology: Movement and Communication	1/3
BB 3102	Human Anatomy & Physiology: Transport and Maintenance	1/3
BB 3620	Developmental Biology	1/3
BME 2211	Biomedical Data Analysis	1/3
BME 3111	Physiology and Engineering	1/3
BME 3300	Biomedical Engineering Design	1/3
BUS 2080	Data Analysis for Decision Making	1/3
CS 3041	Human-Computer Interaction	1/3
CS 3043	Social Implications of Information Processing	1/3
CS 4341	Introduction to Artificial Intelligence	1/3
CS 4445	Data Mining and Knowledge Discovery in Databases	1/3
DS 3010	Data Science III: Computational Data Intelligence	1/3
EN 1257	Introduction to African American Literature and Culture	1/3
EN 2225	The Literature of Sin	1/3
EN 2251	Moral Issues in the Modern Novel	1/3
ID 2050/SS 2050	Social Science Research for the IQP	1/3
IMGD 2000	Social Issues in Interactive Media and Games	1/3
INTL 1100	Introduction to International and Global Studies	1/3
INTL 1200	Introduction to Asia	1/3
INTL 2210	Popular Culture and Social Change in Asia	1/3
INTL 2410	Modern Africa	1/3
MA 2612	Applied Statistics II	1/3
MA 2621	Probability for Applications	1/3
MA 3631	Mathematical Statistics	1/3
MKT 4030	Achieving Strategic Effectiveness	1/3
OBC 1010	Leadership Practice	1/3
PY 2711	Epistemology	1/3
PY 2716/RE 2716	Gender, Race, and Class	1/3
PY 2718	Existentialism and Phenomenology	1/3
RE 2721	Religion and Culture	1/3
RE 2722	Modern Problems of Belief	1/3

For the most recent list of psychology-related courses, students should speak with their advisor.

Basic Science, Computer Science, and/or Engineering (Minimum 5/3 Units)

Must include 1/3 unit of biology. Must include 1/3 unit of computer science (except CS 2022 and CS 3043).

Mathematics (Minimum 3/3 Units)

Must include 2/3 units of calculus and 1/3 unit of statistics.

Electives (Minimum 3/3 Units)

The 1 unit of electives must be approved by the Director of the Psychological Science Undergraduate Program.

Major Qualifying Project (Minimum 3/3 Units)

Minor in Psychological Science

Degree Type
Minor

The minor in Psychological Science allows students to extend their study of Psychology beyond the Social Sciences Requirement without majoring in Psychological Science. Students who, for personal or career purposes, want to develop an understanding of the science of human thought and behavior should consider a minor in psychology. The minor balances breadth and depth in psychology and requires a capstone research experience. Students interested in declaring a minor in Psychological Science may consult any of the following core members of the Psychological & Cognitive Sciences program: Prof. James Doyle, Prof. Richard Lopez, Prof. Erin Ottmar, Prof. Angela Rodriguez, Prof. Stacy Shaw, Prof. Jeanine Skorinko.

The Psychological Science minor consists of a total of two units of work in psychology distributed as follows:

1. Foundations (Minimum 2/3 Units)

At least two foundational courses from the following list:

Item #	Title	Units
PSY 1400	Introduction to Psychological Science	1/3
PSY 1401	Cognitive Psychology	1/3
PSY 1402	Social Psychology	1/3
PSY 1404	Developmental Psychology	1/3
PSY 1412	Mental Health	1/3
PSY 1504	Strategies for Improving Cognitive Skills	1/3
PSY 1800	Special Topics in Psychological Science	

2. Advanced courses (Minimum 2/3 Unit)

At least two courses from the following list:

Item #	Title	Units
ENV 2500/PSY 2500	Psychology for Sustainability	1/3
MU 2501/PSY 2501	Music and Mind	1/3
PSY 2401	The Psychology of Education	1/3
PSY 2406	Cross-Cultural Psychology: Human Behavior in Global Perspective	1/3
PSY 2407	Psychology of Gender	1/3
PSY 2408	Health Psychology	1/3
PSY 2410	School Psychology	1/3
PSY 2504	Human Sexuality	1/3
PSY 2800	Special Topics in Psychological Science	
PSY 3800	Special Topics in Psychological Science	
PSY 4800	Special Topics in Psychological Science	

3. Capstone research experience (Minimum 1/3 Unit)

The capstone research experience may be satisfied by successful completion of one of the following three courses that include a significant research project among their requirements:

Item #	Title	Units
PSY 3400	Survey Design and Methodology	1/3
PSY 3500	Experimental Design and Analysis	1/3
PSY 4110	Psychophysiology	1/3

Alternatively, the capstone research experience may be satisfied by conducting independent research in a psychology laboratory under the direction of a Psychological Science faculty member. Independent research projects are registered under one of the following designations:

Item #	Title	Units
PSY 2900	Introduction to Research in Psychological Science	0/6
PSY 3900	Research in Psychological Science	0/6
PSY 4900	Advanced Research in Psychological Science	0/6

4. Free elective (Minimum 1/3 Unit)

The sixth course may be chosen from courses approved for any of the above categories: Foundations, Advanced Courses, or Capstone Research Experiences.

Note: One psychology related course from another discipline may count under Free Elective with the permission of the Psychological and Cognitive Sciences Program Review Committee.

Psychological Science Major with a Concentration in Diversity Science

Degree Type

Concentration

Psychological Science Majors who are interested in psychological study of diversity can choose to complete a concentration in Diversity Science. To complete the concentration, students must complete 2 units of coursework from the approved list of courses related to diversity, equity, and inclusion.

All students completing this concentration will need to complete an MQP that relates to Diversity Science.

5/3 units should come from Psychological Science and may include (see Note 1):

Item #	Title	Units
	PSY 2900, 3900, or 4900 Research in Psychological Science	
	PSY 1800, 2800, 3800, 4800: Diversity Science Related Topics	
GOV 3000/PSY 3000	Psychology and Law	1/3
PSY 1404	Developmental Psychology	1/3
PSY 1412	Mental Health	1/3
PSY 2401	The Psychology of Education	1/3
PSY 2406	Cross-Cultural Psychology: Human Behavior in Global Perspective	1/3
PSY 2407	Psychology of Gender	1/3
PSY 2408	Health Psychology	1/3
PSY 2410	School Psychology	1/3
PSY 2504	Human Sexuality	1/3

NOTES:
1. Only one course in this subset can be at the 1000-level

1/3 unit can come from a related course in another discipline that is related to the students area of interest or it may be an additional Diversity Science Psych Science course.

Related courses need approval by the Diversity Science Advisor and may include courses such as:

Item #	Title	Units
DEV 1200	International Development and Society	1/3
EN 1257	Introduction to African American Literature and Culture	1/3
EN 2251	Moral Issues in the Modern Novel	1/3
ENV 1100	Introduction to Environmental Studies	1/3
ENV 2700	Social Media, Social Movements, and the Environment	1/3
GN 3513	Survey of German Civilization and Culture from 1871 to the Present	1/3
HI 1311	Introduction to American Urban History	1/3
HI 1322	Introduction to European History	1/3
HI 2341	Contemporaryworld Issues in Historical Perspective	1/3
ID 3525/SP 3525	Spanish American Film/Media: Cultural Issues	1/3
INTL 2210	Popular Culture and Social Change in Asia	1/3
MU 3001	World Music	1/3
PY 2712	Social and Political Philosophy	1/3
PY 3712	Philosophy of Religion	1/3
RE 2721	Religion and Culture	1/3
SOC 1202	Introduction to Sociology and Cultural Diversity	1/3
SP 3523	Topics in Latin American Culture	1/3
SP 3528	Spanish Culture and Civilization	1/3
WR 3300	Cross-Cultural Communication	1/3

Psychological Science Major with a Concentration in Psychobiology

Degree Type

Concentration

1. Psychological Science Majors who are interested in the biological aspects of psychology can choose to complete a concentration in Psychobiology. To complete the concentration, students must complete 2 units of coursework from the approved list of courses related to psychobiology.
2. All students completing this concentration will need to complete an MQP that relates to psychobiology.

2/3 units should come from the Psychological Science and may include (see Note 1):

Item #	Title	Units
PSY 1404	Developmental Psychology	1/3
PSY 1412	Mental Health	1/3
PSY 2408	Health Psychology	1/3
PSY 2504	Human Sexuality	1/3
PSY 4110	Psychophysiology	1/3

4/3 units should come from Biology & Biotechnology and may include (see Note 1):

Item #	Title	Units
BB 1025	Human Biology	1/3
BB 1035	Biotechnology	1/3
BB 2003	Fundamentals of Microbiology	1/3
BB 2050	Animal Behavior	1/3
BB 2550	Cell Biology	1/3

NOTES:
1. Only one course in this subset can be at the 1000-level

Note: You cannot get credit for PSY 2502 and PSY 4110. Starting 2021-2022 PSY 2502 will no longer be offered and PSY 4110 will be offered.

For the most recent list of psychology-related courses, students should speak with their advisor

Technology, Policy, and Sustainability Program

FACULTY: P. Agupusi, C. Brown, A. Ismael, R. Krueger, T. Masiki, O. Pavlov, M. J. Radzicki, K. Saeed, M. L. Sagna, A. Smith, G. Somasse, E. Stoddard

The Technology, Policy, and Sustainability Program trains students to investigate and design meaningful and appropriate solutions for the social, economic, environmental, and technical grand challenges of our time. We confront these challenges from multiple perspectives and through examining bridging conventional with the unconventional.

Students in our program work alongside faculty, as well as independently, to advance knowledge of these challenges and develop just and sustainable solutions to them. Our areas of expertise, which are postured globally, are: design for social justice, policy evaluation, the economics of inequality, the environment, sustainability, and systems thinking.

Why study at WPI? As an undergraduate you study with renowned program faculty from across campus to form a meaningful interdisciplinary perspective on global grand challenges. You will collaborate with innovators in the fields of engineering, natural sciences, the social sciences, and humanities to fulfill WPI's core mission: to create, discover, and convey knowledge at the frontiers of technological academic inquiry for the betterment of society. The experience will offer you the cross-cutting analytical frameworks and design skills to develop a systemic understanding of your skills and interests and their place in the community.

The program offers an undergraduate experience with areas of specialization and concentrations that reflect unique form of publicly engaged scholarship of our program, department, and WPI. Students who excel in their major may wish to consider pursuing our BA/MS program in Science and Technology for Innovation in Global Development. This program offers students from all backgrounds a global perspective in areas ranging from data science and biomedical engineering, to business and entrepreneurship, international development, or health sciences.

About Us

We are critical, purpose-driven scholars from economics, human geography, international development, political science, psychology, sociology, cultural studies, systems thinking, and human- environment relations in a global polytechnic community. Here, we collaborate with faculty, students, policymakers, and community partners from across campus and the world to examine the challenges surrounding sustainable design, including solutions for economic security, ecological integrity, and social justice. This arrangement uniquely positions us to analyze, inform, and shape responses to society's grand challenges, locally and globally. We are leaders in urban sustainability and planning; critical race studies; environmental and climate justice; global development; economics; system dynamics; cross-cultural design for technology and innovation; and policy and evaluation.

Our faculty actively work towards and promote a culture of belonging, equity, and integrity. Living deliberately by these values and employing them in our teaching and research upholds our belief that science, technology, and innovation, are crucial to society's existence, but these interventions alone cannot bring about a truly sustainable society.

Social systems, political institutions, and policies must be constantly examined and refined to support the diverse and sometimes competing ends. As a student in our program you will see your work - as natural scientists, engineers, social scientists, and humanists - in exciting new ways that will help you develop marketable professional skills. In parallel, you will cultivate your innovative capacity across the necessary domains to make the world a better place.

Our Vision

To be transdisciplinary hub for collaboration among students, faculty, and our global partners to creatively investigate and address the global grand challenges, whether at the local, regional, or global scale.

Our Mission

We strive to be thinkers and doers who work with students to solve increasingly complex grand challenges through domestic and international partnerships. We will use cutting-edge technical knowledge, rigorous analytical skills, creativity, and inclusivity of culture and context to develop concise solutions to real world problems.

Our Degree Offerings

Currently, our program offers three degrees: Environmental and Sustainability Studies, Economics, and the new Policy Studies degree. In addition to these degrees, we offer minors in economics, system dynamics, science and engineering for development These cross-cutting offerings help you understand the role of your work in society so that you can realize your innovative potential in the service of people and the environment.

Environmental and Sustainability Studies Major

Degree Type

Bachelor of Arts

Distribution Requirements

Environmental and Sustainability Studies Core (Minimum 6/3 Units)

Only courses with the prefix ENV count toward this requirement. Must include the senior seminar in environmental studies.

Environmental Studies (ENV) Courses

Item #	Title	Units
ENV 1100	Introduction to Environmental Studies	1/3
ENV 1500	Introduction to Geographical Information Systems	1/3
ENV 2200	Environmental Studies in the Various Disciplines	1/3
ENV 2201	Planning for Sustainable Communities	1/3
ENV 2310	Environmental Governance and Innovation	1/3
ENV 2500/PSY 2500	Psychology for Sustainability	1/3
ENV 2600	Environmental Problems in the Developing World	1/3
ENV 2700	Social Media, Social Movements, and the Environment	1/3
ENV 2710	Designing for Climate Resilience and Justice	1/3
ENV 2800	Special Topics in Environmental and Sustainability Studies	
ENV 2900	The Green Economy and Models for Alternative ForMS of Development	1/3
ENV 3100	Adventures in Sustainable Urbanism	1/3
ENV 3500	Women and the Environment	1/3
ENV 4400	Senior Seminar in Environmental Studies	1/3
ENV 4800	Special Topics in Environmental and Sustainability Studies	
GOV 2319/ENV 2319	Global Environmental Politics	1/3

Mathematics and Basic Science (Minimum 8/3 Units)

Must include 2/3 unit of calculus, 1/3 unit of statistics, 2/3 unit of chemistry, and 2/3 unit of biology. May include 1/3 unit of basic engineering with the permission of the Environmental Studies Program Review Committee.

Calculus Courses

Item #	Title	Units
CS 4033/MA 3457	Numerical Methods for Calculus and Differential Equations	1/3
MA 1020	Calculus I with Preliminary Topics	1/3
MA 1021	Calculus I	1/3
MA 1022	Calculus II	1/3
MA 1023	Calculus III	1/3
MA 1024	Calculus IV	1/3
MA 1033	Theoretical Calculus III	1/3
MA 1034	Theoretical Calculus IV	1/3
MA 1120	Calculus II (Semester Version)	1/3
MA 2251	Vector and Tensor Calculus	1/3
MA 3457/CS 4033	Numerical Methods for Calculus and Differential Equations	1/3
MA 3475	Calculus of Variations	1/3

Statistics Courses

Item #	Title	Units
MA 2610	Applied Statistics for the Life Sciences	1/3
MA 2611	Applied Statistics I	1/3
MA 2612	Applied Statistics II	1/3
MA 3631	Mathematical Statistics	1/3

Chemistry Courses

Item #	Title	Units
BB 4170/CH 4170	Experimental Genetic Engineering	1/3
BB 4190/CH 4190	Regulation of Gene Expression	1/3
CH 1010	Chemical Properties, Bonding, and Forces	1/3
CH 1020	Chemical Reactions	1/3
CH 1030	Kinetics, Equilibrium and Thermodynamics	1/3
CH 1040	Spectroscopy in Organic and Polymer Chemistry	1/3
CH 2310	Organic Chemistry I	1/3
CH 2320	Organic Chemistry II	1/3
CH 2330	Organic Chemistry III	1/3
CH 2360	Organic Laboratory	1/3
CH 2640	Experimental Chemistry I: Instrumental Analysis	1/3
CH 2650	Modern Physical Chemistry Methods	1/3
CH 2660	Organic Synthesis and Analysis Laboratory	1/3
CH 2670	Investigation of Coordination Complexes Through Inquiry	1/3
CH 3310	Advanced Organic Chemistry	1/3
CH 3410	Structure, Bonding, and Reactivity in Inorganic Chemistry	1/3
CH 3510	Chemical Thermodynamics	1/3
CH 3530	Quantum Chemistry	1/3
CH 3550	Chemical Dynamics	1/3
CH 4110	Protein Structure and Function	1/3
CH 4120	Lipids and Biomembrane Functions	1/3
CH 4130	Nucleic Acids and Bioinformation	1/3
CH 4140	Metabolism and Disease	1/3
CH 4150	Enzymology and Protein Characterization Laboratory	1/3
CH 4160	Membrane Biophysics	1/3
CH 4330	Organic Synthesis	1/3
CH 4420	Principles and Applications of Group Theory in Chemistry	1/3
CH 4520	Chemical Statistical Mechanics	1/3

Biology Courses

Item #	Title	Units
BB 1001	Introduction to Biology	1/3
BB 1002	Environmental Biology	1/3
BB 1003/BCB 1003	Exploring Bioinformatics and Computational Biology	1/3
BB 1025	Human Biology	1/3
BB 1035	Biotechnology	1/3
BB 1045	Biodiversity	1/3
BB 2002	Microbiology	1/3
BB 2003	Fundamentals of Microbiology	1/3
BB 2030	Plant Diversity	1/3
BB 2040	Principles of Ecology	1/3
BB 2050	Animal Behavior	1/3
BB 2550	Cell Biology	1/3
BB 2902	Enzymes, Proteins, and Purification	1/6
BB 2903	Anatomy and Physiology	1/6
BB 2904	Ecology, Environment, and Animal Behavior	1/6
BB 2915	Searching for Solutions in Soil: Microbial and Molecular Investigations	1/3
BB 2917	Hunting for Phage	1/3
BB 2920	Genetics	1/3
BB 2950	Molecular Biology	1/3
BB 3003	Medical Microbiology: Plagues of the Modern World, a Case Study Approach	1/3
BB 3010/BCB 3010	Simulation in Biology	1/3
BB 3050	Cancer Biology	1/3
BB 3080	Neurobiology	1/3
BB 3101	Human Anatomy & Physiology: Movement and Communication	1/3
BB 3102	Human Anatomy & Physiology: Transport and Maintenance	1/3
BB 3120	Plant Physiology	1/3
BB 3140	Evolution: Pattern and Process	1/3
BB 3512	Molecular Genetics Lab	1/6
BB 3513	Cell Culture Techniques for Animal Cells	1/6
BB 3515	Physiologic Systems Laboratory	1/3
BB 3517	Fermentation	1/6
BB 3519	Protein Purification	1/6
BB 3521	Microscopy	1/6
BB 3525	Plant Physiology	1/6
BB 3526	Phage Hunters: the Analysis	1/6
BB 3527	Molecular Biology and Genetic Engineering: Approaches and Applications	1/3
BB 3530	Immunotherapies: The Next Generation of Pharmaceuticals	1/3
BB 3570	Cell Culture Models for Tissue Regeneration	1/3
BB 3620	Developmental Biology	1/3
BB 3920	Immunology	1/3
BB 4150	Environmental Change: Problems and Approaches	1/3
BB 4170/CH 4170	Experimental Genetic Engineering	1/3
BB 4190/CH 4190	Regulation of Gene Expression	1/3
BB 4260	Synthetic Biology	1/3
BB 4801/BCB 4001	Bioinformatics	1/3
BB 4900	Capstone Experience in Biology and Biotechnology	1/3

Basic Engineering Courses

Environmental Science and Engineering (Minimum 9/3 Units)

All courses with prefixes BB, CE, CH, CHE, ES, GE, and PH may qualify under this requirement. BB courses must be at the 2000 level or higher. Must include 1/3 unit of ecology. Must include 1/3 unit of engineering at the 2000 level or higher. The 3 units of environmental science and engineering courses must be coherently defined and approved by the Environmental Studies Program Review Committee.

Biology and Biotechnology (BB) Courses

Item #	Title	Units
BB 2002	Microbiology	1/3
BB 2003	Fundamentals of Microbiology	1/3
BB 2030	Plant Diversity	1/3
BB 2040	Principles of Ecology	1/3
BB 2050	Animal Behavior	1/3
BB 2550	Cell Biology	1/3
BB 2902	Enzymes, Proteins, and Purification	1/6
BB 2903	Anatomy and Physiology	1/6
BB 2904	Ecology, Environment, and Animal Behavior	1/6
BB 2915	Searching for Solutions in Soil: Microbial and Molecular Investigations	1/3
BB 2917	Hunting for Phage	1/3
BB 2920	Genetics	1/3
BB 2950	Molecular Biology	1/3
BB 3003	Medical Microbiology: Plagues of the Modern World, a Case Study Approach	1/3
BB 3010/BCB 3010	Simulation in Biology	1/3
BB 3050	Cancer Biology	1/3
BB 3080	Neurobiology	1/3
BB 3101	Human Anatomy & Physiology: Movement and Communication	1/3
BB 3102	Human Anatomy & Physiology: Transport and Maintenance	1/3
BB 3120	Plant Physiology	1/3
BB 3140	Evolution: Pattern and Process	1/3
BB 3512	Molecular Genetics Lab	1/6
BB 3513	Cell Culture Techniques for Animal Cells	1/6
BB 3515	Physiologic Systems Laboratory	1/3
BB 3517	Fermentation	1/6
BB 3519	Protein Purification	1/6
BB 3521	Microscopy	1/6
BB 3525	Plant Physiology	1/6
BB 3526	Phage Hunters: the Analysis	1/6
BB 3527	Molecular Biology and Genetic Engineering: Approaches and Applications	1/3
BB 3530	Immunotherapies: The Next Generation of Pharmaceuticals	1/3
BB 3570	Cell Culture Models for Tissue Regeneration	1/3
BB 3620	Developmental Biology	1/3
BB 3920	Immunology	1/3
BB 4150	Environmental Change: Problems and Approaches	1/3
BB 4170/CH 4170	Experimental Genetic Engineering	1/3
BB 4190/CH 4190	Regulation of Gene Expression	1/3
BB 4260	Synthetic Biology	1/3
BB 4801/BCB 4001	Bioinformatics	1/3
BB 4900	Capstone Experience in Biology and Biotechnology	1/3

Civil and Environmental Engineering (CE) Courses

Item #	Title	Units
CE 1030	Civil Engineering and Computer Fundamentals	1/3
CE 2000	Analytical Mechanics I	1/3
CE 2001	Analytical Mechanics II	1/3
CE 2002	Introduction to Analysis and Design	1/3
CE 2020	Surveying	1/3
CE 3006	Design of Steel Structures	1/3
CE 3008	Design of Reinforced Concrete Structures	1/3
CE 3010	Structural Engineering	1/3
CE 3020	Project Management	1/3
CE 3022	Legal Aspects of Professional Practice	1/3
CE 3025	Project Evaluation	1/3
CE 3026	Materials of Construction	1/3
CE 3030	Fundamentals of Civil Engineering Autocad	1/3
CE 3031	Building Information Modeling: Software Tools and Principles	1/3
CE 3041	Soil Mechanics	1/3
CE 3044	Foundation Engineering	1/3
CE 3050	Traffic Engineering	1/3
CE 3051	Pavement Engineering	1/3
CE 3059	Environmental Engineering	1/3
CE 3060	Water Treatment	1/3
CE 3061	Sustainable Wastewater Engineering: Treatment and Reuse	1/3
CE 3062	Hydraulics	1/3
CE 3070	Urban and Environmental Planning	1/3
CE 3074	Environmental Analysis	1/3
CE 4007	Matrix Analysis of Structures	1/3
CE 4060	Environmental Engineering Laboratory	1/3
CE 4061	Hydrology	1/3
CE 4063/CHE 4063	Transport & Transformations in the Environment	1/3
CE 4071	Land Use Development and Controls	1/3
CE 4600	Hazardous and Industrial Waste Management	1/3
CE 4610	Solid Waste Engineering	1/3

Chemistry and Biochemistry (CH) Courses

Item #	Title	Units
BB 4170/CH 4170	Experimental Genetic Engineering	1/3
BB 4190/CH 4190	Regulation of Gene Expression	1/3
CH 1010	Chemical Properties, Bonding, and Forces	1/3
CH 1020	Chemical Reactions	1/3
CH 1030	Kinetics, Equilibrium and Thermodynamics	1/3
CH 1040	Spectroscopy in Organic and Polymer Chemistry	1/3
CH 2310	Organic Chemistry I	1/3
CH 2320	Organic Chemistry II	1/3
CH 2330	Organic Chemistry III	1/3
CH 2360	Organic Laboratory	1/3
CH 2640	Experimental Chemistry I: Instrumental Analysis	1/3
CH 2650	Modern Physical Chemistry Methods	1/3
CH 2660	Organic Synthesis and Analysis Laboratory	1/3
CH 2670	Investigation of Coordination Complexes Through Inquiry	1/3
CH 3310	Advanced Organic Chemistry	1/3
CH 3410	Structure, Bonding, and Reactivity in Inorganic Chemistry	1/3
CH 3510	Chemical Thermodynamics	1/3
CH 3530	Quantum Chemistry	1/3
CH 3550	Chemical Dynamics	1/3
CH 4110	Protein Structure and Function	1/3
CH 4120	Lipids and Biomembrane Functions	1/3
CH 4130	Nucleic Acids and Bioinformation	1/3
CH 4140	Metabolism and Disease	1/3
CH 4150	Enzymology and Protein Characterization Laboratory	1/3
CH 4160	Membrane Biophysics	1/3
CH 4330	Organic Synthesis	1/3
CH 4420	Principles and Applications of Group Theory in Chemistry	1/3
CH 4520	Chemical Statistical Mechanics	1/3

Chemical Engineering (CHE) Courses

Item #	Title	Units
CE 4063/CHE 4063	Transport & Transformations in the Environment	1/3
CHE 1011	Introduction to Chemical Engineering	1/3
CHE 2011	Chemical Engineering Fundamentals	1/3
CHE 2012	Elementary Chemical Processes	1/3
CHE 2013	Applied Chemical Engineering Thermodynamics	1/3
CHE 2014	Advanced Chemical Processes	1/3
CHE 3201	Kinetics and Reactor Design	1/3
CHE 3301	Introduction to Biological Engineering	1/3
CHE 3501	Applied Mathematics in Chemical Engineering	1/3
CHE 3702	Energy Challenges in the 21st Century	1/3
CHE 3722	Bioenergy	1/3
CHE 4401	Unit Operations of Chemical Engineering I	1/3
CHE 4402	Unit Operations of Chemical Engineering II	1/3
CHE 4403	Chemical Engineering Design	1/3
CHE 4404	Chemical Plant Design Project	1/3
CHE 4405	Chemical Process Dynamics and Control Laboratory	1/3
CHE 4410	Chemical Process Safety Design	1/3

Engineering Science Interdisciplinary (ES) Courses

Item #	Title	Units
ES 1020	Introduction to Engineering	1/3
ES 1310	Introduction to Computer Aided Design	1/3
ES 1500	Fundamentals of Systems Thinking	1/3
ES 2001	Introduction to Materials Science	1/3
ES 2501	Introduction to Static Systems	1/3
ES 2502	Stress Analysis	1/3
ES 2503	Introduction to Dynamic Systems	1/3
ES 2800	Environmental Impacts of Engineering Decisions	1/3
ES 3001	Introduction to Thermodynamics	1/3
ES 3002	Mass Transfer	1/3
ES 3003	Heat Transfer	1/3
ES 3004	Fluid Mechanics	1/3
ES 3011	Control Engineering I	1/3
ES 3323	Advanced Computer Aided Design	1/3
ES 3501	A Project-Based Introduction to Systems Engineering	1/3

Geosciences (GE) Courses

Item #	Title	Units
GE 2341	Geology	1/3

Physics (PH) Courses

Item #	Title	Units
PH 1110	General Physics—Mechanics	1/3
PH 1111	Principles of Physics—Mechanics	1/3
PH 1120	General Physics—Electricity and Magnetism	1/3
PH 1121	Principles of Physics—Electricity and Magnetism	1/3
PH 1130	Modern Physics	1/3
PH 1140	Oscillations and Waves	1/3
PH 1150	Introductory Physics of Living Systems	1/3
PH 2101	Principles of Thermodynamics	1/3
PH 2201	Intermediate Mechanics I	1/3
PH 2202	Intermediate Mechanics II	1/3
PH 2301	Electromagnetic Fields	1/3
PH 2501	Photonics	1/3
PH 2502	Lasers	1/3
PH 2510	Atomic Force Microscopy	1/3
PH 2520	Introduction to Astrophysics	1/3
PH 2540	Solar Systems	1/3
PH 2550/AE 2550	Atmospheric and Space Environments	1/3
PH 2601	Photonics Laboratory	1/3
PH 2651	Intermediate Physics Laboratory	1/3
PH 3206	Statistical Physics	1/3
PH 3301	Electromagnetic Theory	1/3
PH 3401	Quantum Mechanics I	1/3
PH 3402	Quantum Mechanics II	1/3
PH 3501	Relativity	1/3
PH 3502	Solid State Physics	1/3
PH 3503	Nuclear Physics	1/3
PH 3504	Optics	1/3
PH 4201/PH 511	Advanced Classical Mechanics	1/3

Basic Social Science and Humanities (Minimum 3/3 Units)

Must include 1/3 unit of economics, 1/3 unit of public policy or political science, and 1/3 unit of either history or philosophy.

Economics

Item #	Title	Units
ECON 1110	Introductory Microeconomics	1/3
ECON 1120	Introductory Macroeconomics	1/3
ECON 2110	Intermediate Microeconomics	1/3
ECON 2120	Intermediate Macroeconomics	1/3
ECON 2126	Public Economics	1/3
ECON 2130	Econometric Modeling	1/3
ECON 2135	Information Economics and Policy	1/3
ECON 2145	Behavioral Economics	1/3
ECON 2155	Experimental Economics	1/3
ECON 2910/ETR 2910	Economics and Entrepreneurship	1/3

Public Policy or Political Science

Item #	Title	Units
ENV 1100	Introduction to Environmental Studies	1/3
ENV 1500	Introduction to Geographical Information Systems	1/3
ENV 2200	Environmental Studies in the Various Disciplines	1/3
ENV 2201	Planning for Sustainable Communities	1/3
ENV 2310	Environmental Governance and Innovation	1/3
ENV 2500/PSY 2500	Psychology for Sustainability	1/3
ENV 2600	Environmental Problems in the Developing World	1/3
ENV 2700	Social Media, Social Movements, and the Environment	1/3
ENV 2710	Designing for Climate Resilience and Justice	1/3
ENV 2800	Special Topics in Environmental and Sustainability Studies	
ENV 4400	Senior Seminar in Environmental Studies	1/3
ENV 4800	Special Topics in Environmental and Sustainability Studies	
ENV1100	Introduction to Environmental Studies	1/3
GOV 1301	U.S. Government	1/3
GOV 1303	American Public Policy	1/3
GOV 1310	Law, Courts, and Politics	1/3
GOV 1320	Topics in International Politics	1/3
GOV 2302	Science-Technology Policy	1/3
GOV 2310	Constitutional Law: Foundations of Government	1/3
GOV 2311	Environmental Policy and Law	1/3
GOV 2313	Intellectual Property Law	1/3
GOV 2314/ID 2314	Cyberlaw and Policy	1/3
GOV 2315	Privacy: Laws, Policy, Technology, and How They Fit Together	1/3
GOV 2319/ENV 2319	Global Environmental Politics	1/3
GOV 2320	Constitutional Law: Civil Rights and Liberties	1/3
GOV 3000/PSY 3000	Psychology and Law	1/3
GOV 3312	International Environmental Policy	1/3
ID 2050/SS 2050	Social Science Research for the IQP	1/3
SOC 1500	The Sociology of Race	1/3

History or Philosophy

Item #	Title	Units
HI 1311	Introduction to American Urban History	1/3
HI 1313	The US and the World	1/3
HI 1314	Introduction to Early American History	1/3
HI 1322	Introduction to European History	1/3
HI 1330	Introduction to the History of Science and Technology	1/3
HI 1333	Introduction to American Histories of Protest and Power	1/3
HI 1345	Atlantic Worlds	1/3
HI 1350	Introduction to Environmental History	1/3
HI 2310	Topics in Urban History	1/3
HI 2311	American Colonial History	1/3
HI 2313	American History, 1789-1877	1/3
HI 2314	American History, 1877-1920	1/3
HI 2315	The Shaping of Post-1920 America	1/3
HI 2316	Twentieth Century American Foreign Relations	1/3
HI 2318	Topics in Law, Justice and American Society	1/3
HI 2320	Modern European History	1/3
HI 2328	History of Revolutions in the Twentieth Century	1/3
HI 2329	European Empires	1/3
HI 2335	Topics in the History of American Science and Technology	1/3
HI 2341	Contemporaryworld Issues in Historical Perspective	1/3
HI 2343	East Asia: China at the Center	1/3
HI 2345	Welcome to Paradise: the U.S. and the Caribbean	1/3
HI 2350	Topics in the History of Science	1/3
HI 2351	History of Ecology	1/3
HI 2400	Topics in Environmental History	1/3
HI 2401	U.S. Environmental History	1/3
HI 2403	Global Environmental History	1/3
HI 2900	Topics in Gender and History	1/3
HI 2913	Capitalism and Its Discontents	1/3
HI 2921	Topics in Modern European History	1/3
HI 2930	Topics in Latin American History	1/3
HI 3312	Topics in American Social History	1/3
HI 3314	The American Revolution	1/3
HI 3316	Topics in Twentieth-Century U.S. History	1/3
HI 3317	Topics in Environmental History	1/3
HI 3331	Topics in the History of European Science and Technology	1/3
HI 3333	Topics in American Technological Development	1/3
HI 3334	Topics in the History of American Science and Technology	1/3
HI 3335	Topics in the History of Non-Western Science and Technology	1/3
HI 3341	Topics in Imperial and Postcolonial History	1/3
HI 3343	Topics in Asian History	1/3
HI 3344	Pacific Worlds	1/3
PY 1731/RE 1731	Introduction to Philosophy and Religion	1/3
PY 2711	Epistemology	1/3
PY 2712	Social and Political Philosophy	1/3
PY 2713	Bioethics	1/3
PY 2716/RE 2716	Gender, Race, and Class	1/3
PY 2717	Philosophy and the Environment	1/3
PY 2718	Existentialism and Phenomenology	1/3
PY 2719	Philosophy of Science	1/3
PY 2731/RE 2731	Ethics	1/3
PY 2734	Philosophy and Spirituality	1/3
PY 3712	Philosophy of Religion	1/3

PY 3721/RE 3721	Topics in Religion	1/3
RE 3711/PY 3711	Topics in Philosophy	1/3

Environmental Social Science or Humanities (Minimum 6/3 Units)

Must include 1/3 unit environmental economics, 1/3 unit environmental policy, 1/3 unit environmental philosophy, and 1/3 unit environmental history.

Major Qualifying Project (Minimum 3/3 Units)

The MQP is expected to provide an integrative capstone research experience in Environmental and Sustainability Studies. Several types of MQPs are possible: a research study in a particular science or social science discipline, a holistic examination of an environmental problem from an interdisciplinary perspective, or a philosophical or historical analysis of an environmental issue. WPI faculty from academic disciplines including biology, chemistry, economics, geography, history, philosophy, psychology and public policy are associated with the Environmental Studies program and can advise Environmental Studies MQPs related to their area of expertise.

Environmental IQP Opportunities

WPI students can complete an IQP in a wide variety of areas at the intersection of society and technology, and there is no requirement that Environmental and Sustainability Studies students do an environmentally-related IQP. However, for interested students, numerous opportunities exist for environmental IQPs on campus and at off-campus centers.Many other environmentally themed projects are offered on campus as well. Typical project topics include issues of public health, renewable energy, land conservation, air quality and water quality, urban environments, and environmental justice. In some circumstances students may, with the approval of their IQP advisor, their academic advisor, and the Environmental Studies Program Review Committee, complete additional work on an environmental IQP that qualifies the project to count as an Environmental Studies MQP. However, students must still complete two separate, distinct projects, one IQP and one MQP, to meet the requirements for graduation.

Economic Science

Degree Type
Bachelor of Science

A. Smith: Program Director

Economists study how both individuals and institutions make decisions about the utilization and distribution of resources. They also monitor economic data and analyze trends, examine the impact of economic policies and behaviors, and help formulate new policies and anticipate their effects. WPI's economic science major emphasizes the use of computational modeling and experimentation to achieve these goals.

PROGRAM OUTCOMES

In addition to fulfilling WPI's university-wide undergraduate learning outcomes, economic science majors will demonstrate:

1. Command of macro-economic and micro-economic theory.
2. Awareness of economic history and the evolution of thought in economics.
3. Skills in key economic modeling techniques, including econometrics and system dynamics.
4. Skills using data collected in a variety of ways, including surveys, experiments and through observation in the field.
5. Skill in mathematics as required to approach and solve economic problems.
6. Practical understanding of modern business disciplines including accounting and finance.
7. Knowledge of key economic institutions that make policy and influence economic practice.
8. Ability to understand current economic issues in light of economic theories.

9. Ability to approach and solve a practical problem like an economist.
10. Deep understanding of fundamental economic problems in a specific area of application.

Program Distribution Requirements for the Economic Science Major

The normal period of residency at WPI is 16 terms. In addition to the WPI requirements applicable to all students, completion of a minimum of 10 units of study is required in economics, social science, basic science, and mathematics as follows:

Economics (Minimum 9/3 Units)

Must include courses in both micro and macro economic theory at the intermediate level and in econometrics and international trade (available through the Consortium or independent study).

Economics and/or Business (Minimum 2/3 Units)

Must include financial accounting, ACC 2060. May include other relevant business courses as approved by the Departmental Program Review Committee.

Other Social Science (Minimum 2/3 Units)

Modeling Techniques (Minimum 2/3 Units)

Mathematics (Minimum 6/3 Units)

Must include differential equations, integral calculus, and statistics.

Basic Science (Minimum 3/3 Units)

Electives (Minimum 2/3 Units)

MQP (Minimum 3/3 Units)

Concentration Areas Available in Economic Science

Economic Science majors may focus their studies by choosing a Concentration within one of the following two specific areas of Economics: Sustainable Economic Development and Computational Economics. These concentration areas reflect the growing importance of environmental issues and computational tools within the discipline of economics and are areas of strength in teaching and research in the social sciences at WPI. Concentrations within the Economics Science major comply with WPI's requirements for concentrations. Students must complete an MQP and two units of integrated study in the area of their Concentration.

Policy Studies Major

Degree Type

Bachelor of Science

The Policy Studies Major trains students to investigate and design meaningful and appropriate solutions for the social, economic, environmental, and technical grand challenges of our time. We confront these challenges from multiple perspectives and through examining bridging conventional with the unconventional.

Students in our program work alongside faculty, as well as independently, to advance knowledge of these challenges and develop just and sustainable solutions to them. Our areas of expertise, which are postured globally, are: design for social justice, policy evaluation, the economics of inequality, the environment, sustainability, and systems thinking.

Why study at WPI? As an undergraduate you study with renowned program faculty from across campus to form a meaningful interdisciplinary perspective on global grand challenges. You will collaborate with innovators in the fields of engineering, natural sciences, the social sciences, and humanities to fulfill WPI's core mission: to create, discover, and convey knowledge at the frontiers of technological academic inquiry for the betterment of society. The experience will offer you the cross-cutting analytical frameworks and design skills to develop a systemic understanding of your skills and interests and their place in the community.

The program offers an undergraduate experience with areas of specialization and concentrations that reflect unique form of publicly engaged scholarship of our program, department, and WPI. Students who excel in their major may wish to consider pursuing our BS/BA/MS program in Science and Technology for Innovation in Global Development. This program offers students from all backgrounds a global perspective in areas ranging from data science and biomedical engineering, to business and entrepreneurship, international development, or health sciences

DEGREE OUTCOMES

In addition to fulfilling WPI's university-wide undergraduate learning outcomes, Policy Studies Majors will demonstrate:

1. Ability to conduct public policy analysis, technology assessment, or social impact analysis.
2. Understanding of and ability to apply research methods in the social sciences.
3. Ability to communicate effectively the results of a social analysis with policy implications in speech and writing.
4. Understanding of the relationships between technology, policy, and the public interest in different societies.
5. Ability to integrate understanding of science and technology into thinking on the social implications of science and technology.
6. Ability to understand the impacts of government regulation on the future development of a technology or industry.
7. Literacy in the technological aspects of policy issues in the student's area of concentration.
8. Ability to identify and appropriately consider ethical constraints during science and technology policy deliberations and decision-making.

Program Distribution Requirements for the Policy Studies Major

The normal period of residency at WPI is 16 terms. In addition to the WPI requirements applicable to all students, completion of a minimum of 9 2/3 units of study is required as follows:

Foundation Courses (5/3 Units)

Must include the courses below:

Mathematics (Minimum 3/3 Units)

Must include: two Calculus Courses at the level of MA 1020 or higher, and 1 Statistics - MA 2610 or 2611 or 2612.

Basic Sciences (Minimum 3/3 Units)

Must include: one unit of basic science (CH, PH, BB, GE designations).

Core Courses (Minimum 9/3 Units)

Core courses comprise the heart of a WPI Policy Studies degree. To complete this requirement, a student will demonstrate policy analysis and methodological competency, as well as global perspective. Students may also choose to concentrate in a specific policy domain. Please see the interdisciplinary concentrations.

Policy Analysis and Methodological Competency

Must include ECON 3126, ECON 3130, GOV 3100 (Policy Design and Evaluation), DEV 540/DEV 4400 Research Methods, and either ENV 1500 or DS 1010.

Global Perspective

Must include four thematic courses on a region, language, global justice, development, environment, or gender (two must be 2000-level or above and drawn from HUA or SSPS courses).

Science and Engineering Studies (Minimum 6/3 Units)

May be drawn from another major and must be at the 2000-level or above.

Major Qualifying Project (Minimum 3/3 Units)

Environmental and Sustainability Studies Minor

Degree Type

Minor

Students taking minors in environmental studies are expected to designate a member of the Environmental Studies associated faculty as their SS minor advisor, who will assist them in preparing a program that meets the requirements of the minor. Students can obtain assistance at the Environmental Studies Program office in designating an advisor.

Environmental Studies Core (Minimum 2/3 Units)

Only courses with the prefix ENV count toward this requirement.

Item #	Title	Units
ENV 1100	Introduction to Environmental Studies	1/3
ENV 1500	Introduction to Geographical Information Systems	1/3
ENV 2200	Environmental Studies in the Various Disciplines	1/3
ENV 2201	Planning for Sustainable Communities	1/3
ENV 2310	Environmental Governance and Innovation	1/3
ENV 2500/PSY 2500	Psychology for Sustainability	1/3
ENV 2600	Environmental Problems in the Developing World	1/3
ENV 2700	Social Media, Social Movements, and the Environment	1/3
ENV 2710	Designing for Climate Resilience and Justice	1/3
ENV 2800	Special Topics in Environmental and Sustainability Studies	
ENV 2900	The Green Economy and Models for Alternative ForMS of Development	1/3
ENV 3100	Adventures in Sustainable Urbanism	1/3
ENV 3500	Women and the Environment	1/3
ENV 4400	Senior Seminar in Environmental Studies	1/3
ENV 4800	Special Topics in Environmental and Sustainability Studies	
GOV 2319/ENV 2319	Global Environmental Politics	1/3

Environmental Social Science and Humanities (Minimum 3/3 Units)

Students must either select courses for breadth, or they may choose a thematic set of courses for depth. At least two of these courses should be above the 2000 level. Additional ENV courses not counted toward the core requirement may be counted here. Students may substitute up to two courses in environmental science with the approval of the Environmental Studies Program Review Committee.

Approved Social Science and Humanities Courses

Item #	Title	Units
ECON 3117	Environmental Economics	1/3
ECON 3125	Development Economics	1/3
EN 2237	Literature and the Environment	1/3
GOV 2311	Environmental Policy and Law	1/3
GOV 3312	International Environmental Policy	1/3
HI 2351	History of Ecology	1/3
HI 2401	U.S. Environmental History	1/3
HI 3317	Topics in Environmental History	1/3
PY 2717	Philosophy and the Environment	1/3
SD 1510	Introduction to System Dynamics Modeling	1/3

Environmental Studies Capstone (Minimum 1/3 Units)

The capstone requirement will normally be met by taking ENV4400, Senior Seminar in Environmental Studies. With the approval of the Program Review Committee, the capstone requirement may also be fulfilled via independent study. Students are also strongly encouraged to do an environmental/sustainability related IQP.

Example Sequence: ENV Minor with Breadth

Many other sequences are possible.

Item #	Title	Units
	Environmental Studies Core	2/3
	Environmental Studies Capstone	1/3
BB 2040	Principles of Ecology	1/3
HI 2401	U.S. Environmental History	1/3
ECON 3117	Environmental Economics	1/3

Example Sequence: ENV Minor with Depth (Social Science)

Many other sequences are possible.

Item #	Title	Units
	Environmental Studies Core	2/3
	Environmental Studies Capstone	1/3
GOV 2311	Environmental Policy and Law	1/3
GOV 3312	International Environmental Policy	1/3
ECON 3117	Environmental Economics	1/3

Minor in Law and Technology

Degree Type

Minor

As science and technology evolve, there are growing needs for professionals who both understand science and technology and who work within the institutions of the American legal system. At all levels, from federal courts to state regulatory agencies and local planning commissions, policy makers decide issues in an environment of legal rules and principles. Yet to be effective, they must also understand how science and technology can aid their decisions, the methods and conclusions of scientific research, and the social impact of decisions. Without science, environmental regulators cannot decide on measures for hazardous waste disposal, public health - officials cannot evaluate new drug therapies, utility regulators cannot authorize new sources of electric power, judges cannot construe the meaning of medical testimony, and attorneys cannot cross examine an expert witness in a product failure case. Decision makers, and those who attempt to influence them, find that they need to understand science and technology.

The Law and Technology Program is an interdisciplinary minor that can be used to supplement a major, introduce students in science and engineering disciplines to legal studies and prepare students to enter law school upon graduation. Students in the program begin their studies with a foundation in legal institutions and analysis and continue with advanced courses that integrate law and technology. A course in professional communication is also required.

To attain a Minor in Law and Technology, students must complete two units of study (6 courses) as follows:

Legal Fundamental Courses

At least two of the following courses in legal fundamentals (Minimum 2/3 Units)

Item #	Title	Units
BUS 2020	The Legal Environment of Business Decisions	1/3
GOV 1310	Law, Courts, and Politics	1/3
GOV 2310	Constitutional Law: Foundations of Government	1/3
GOV 2320	Constitutional Law: Civil Rights and Liberties	1/3

Intergrate Law and Technology courses

At least two of the following courses which integrate law and technology (Minimum 2/3 Units)
Independent study or experimental courses with the approval of the program director.

One-third unit of IQP may also be credited toward the minor with the approval of the program director.

Item #	Title	Units
CE 3022	Legal Aspects of Professional Practice	1/3
CE 4071	Land Use Development and Controls	1/3
GOV 2302	Science-Technology Policy	1/3
GOV 2311	Environmental Policy and Law	1/3
GOV 2313	Intellectual Property Law	1/3
GOV 2314/ID 2314	Cyberlaw and Policy	1/3
GOV 3312	International Environmental Policy	1/3

Professional Communication

One of the following courses in professional communication (Minimum 1/3 Units)

Item #	Title	Units
WR 1010	Elements of Writing	1/3
WR 2210	Business Writing and Communication	1/3
WR 3112	Rhetorical Theory	1/3
WR 3214	Writing About Disease & Public Health	1/3

Students should review their program of study with the associated faculty and/or pre-law advisor. Students are also encouraged to seek IQP opportunities in Division 53, Law and Technology. Note: only one of the two units may be counted toward other college requirements.

For general policy on the Minor, see description.

Science and Engineering for Development Minor

Degree Type
Minor

Students seeking a DEV Minor should complete this form and submit it to the SSPS office as early in the program of study as possible. The chair of the DEV curriculum committee will be responsible for review and approval of all DEV Minor requests.

WPI policy requires that no more than one unit of course work can be double counted toward other degree requirements.

Successful candidates for the DEV Minor must meet the following requirements.

Complete two units of work that meet the requirements below:

Complete one unit of work in courses thematically related from environmental and sustainability studies, economics, system dynamics, psychology, or international dimensions of science technology policy, The Business School, or an approved combination.

Two of the three courses must be at the 2000-level or above. Some combinations could include:

Item #	Title	Units
	ENV 2310, ENV 2600, and GOV 2319	
	ENV 1100, ENV 2900, and ENV 4400	
	ECON 1110, ECON 2117, and ECON 2125	
	GOV 2301, SD 1510, and GOV 2319	
	PSY 1400, ENV 2400, and PSY 2406	
	ETR 1100, ETR 2900, and ETR 4930	

Governance

Item #	Title	Units
ENV 2310	Environmental Governance and Innovation	1/3
ENV 2600	Environmental Problems in the Developing World	1/3
GOV 2319/ENV 2319	Global Environmental Politics	1/3

Environment and Society

Item #	Title	Units
ENV 1100	Introduction to Environmental Studies	1/3
ENV 2900	The Green Economy and Models for Alternative ForMS of Development	1/3
ENV 4400	Senior Seminar in Environmental Studies	1/3

Development Economics

Item #	Title	Units
ECON 1110	Introductory Microeconomics	1/3
ECON 3117	Environmental Economics	1/3
ECON 3125	Development Economics	1/3

International Political Dynamics

Item #	Title	Units
GOV 2302	Science-Technology Policy	1/3
GOV 2319/ENV 2319	Global Environmental Politics	1/3
SD 1510	Introduction to System Dynamics Modeling	1/3

Psychological Science

Item #	Title	Units
PSY 1400	Introduction to Psychological Science	1/3
PSY 2406	Cross-Cultural Psychology: Human Behavior in Global Perspective	1/3

Social Entrepreneurship

Item #	Title	Units
ETR 1100	Engineering Innovation and Entrepreneurship	1/3
ETR 2900	Social Entrepreneurship	1/3
ETR 4930	Growing and Managing New Ventures	1/3

Complete the following three courses:

Item #	Title	Units
DEV 1200	International Development and Society	1/3
DEV 2200	Case Studies in International Development Policy and Engineering	1/3
DEV 4400	Science, Engineering and Design in International Development	1/3

Complete approved courses and/or project work that reflect global experience

Policy Studies Major with Concentration in Complex Systems Thinking

Degree Type
Concentration

Policy Studies Majors who are interested in Complex Systems Thinking can choose to complete a concentration in Complex Systems Thinking. To complete the concentration, students must complete 2 units of coursework from the following list of approved courses. One unit can be introductory courses, but the second unit must be advanced courses of 3000-level or above.

The two units of coursework should come from the list below.

Item #	Title	Units
ES 1500	Fundamentals of Systems Thinking	1/3
ES 2800	Environmental Impacts of Engineering Decisions	1/3
ES 3501	A Project-Based Introduction to Systems Engineering	1/3
OIE 3460	Simulation Modeling and Analysis	1/3
SD 1510	Introduction to System Dynamics Modeling	1/3
SD 2520	Modeling Economic and Social Systems	1/3
SD 2530	Advanced Topics in System Dynamics Modeling	1/3
SD 3550	System Dynamics Seminar	1/3
SS 1505	Games for Understanding Complexity	1/3

All students completing this concentration will need to complete an MQP that relates to Complex Systems Thinking.

Policy Studies Major with Concentration in Development and the Environment

Degree Type
Concentration

Policy Studies Majors who are interested in the development and environmental aspects of policy can choose to complete a concentration in Development and the Environment.

To complete the concentration, students must complete 2 units of coursework from the following list of approved courses. One unit can be introductory courses, but the second unit must be advanced courses of 3000-level or above:

Item #	Title	Units
DEV 1200	International Development and Society	1/3
DEV 2200	Case Studies in International Development Policy and Engineering	1/3
DEV 4400	Science, Engineering and Design in International Development	1/3
ECON 3100	Economics of Climate Change	1/3
ECON 3117	Environmental Economics	1/3
ECON 3125	Development Economics	1/3
ENV 1100	Introduction to Environmental Studies	1/3
ENV 2310	Environmental Governance and Innovation	1/3
ENV 2600	Environmental Problems in the Developing World	1/3
ENV 3500	Women and the Environment	1/3
GOV 2311	Environmental Policy and Law	1/3
GOV 2319/ENV 2319	Global Environmental Politics	1/3
GOV 3312	International Environmental Policy	1/3

All students completing this concentration will need to complete an MQP that relates to Development and the Environment.

Policy Studies Major with Concentration in Economics

Degree Type

Concentration

Policy Studies Majors who are interested in the economic aspects of policy can choose to complete a concentration in Economics. To complete the concentration, students must complete 2 units of coursework from the approved list of courses in Economics.

All students completing this concentration will need to complete:

Item #	Title	Units
ECON 2110	Intermediate Microeconomics	1/3
ECON 2120	Intermediate Macroeconomics	1/3

The remaining 4/3 units of coursework should come from Economics and may include:

Item #	Title	Units
ECON 2135	Information Economics and Policy	1/3
ECON 2145	Behavioral Economics	1/3
ECON 2155	Experimental Economics	1/3
ECON 2910/ETR 2910	Economics and Entrepreneurship	1/3
ECON 3117	Environmental Economics	1/3
ECON 3125	Development Economics	1/3

All students completing this concentration will need to complete an MQP that relates to Economics.

Policy Studies Major with Concentration in Science Technology Policy

Degree Type

Concentration

Policy Studies Majors who are interested in policy as it relates to science and technology can choose to complete a concentration in Science Technology Policy. To complete the concentration, students must complete 2 units of coursework from the following list of approved courses. One unit can be introductory courses, but the second unit must be advanced courses of 3000-level or above:

The 2 units of coursework should come from:

Item #	Title	Units
BB 1002	Environmental Biology	1/3
BB 1003/BCB 1003	Exploring Bioinformatics and Computational Biology	1/3
BB 1045	Biodiversity	1/3
CS 3043	Social Implications of Information Processing	1/3
DEV 4400	Science, Engineering and Design in International Development	1/3
GOV 2302	Science-Technology Policy	1/3
GOV 2313	Intellectual Property Law	1/3
GOV 2314/ID 2314	Cyberlaw and Policy	1/3
RBE 3100	Social Implications of Robotics	1/3

*Students may also take GOV 210X Engineering and Public Policy

All students completing this concentration will need to complete an MQP that relates to Science and Technology.

Social Science & Policy Studies Program

R. KRUEGER, HEAD; G. SOMASSE, ASSOCIATE HEAD

FACULTY: P. Agupusi, C. Brown, J. K. Doyle, A. Ismael, R. Krueger, R. Lopez, T. Masiki, E. Ottmar, O. Pavlov, M. J. Radzicki, K. J. Rissmiller, A. C. Rodriguez, K. Saeed, M. L. Sagna, K. Schneider (Visiting), S. T. Shaw, J. Skorinko, A. Smith, G. Somasse, E. Stoddard
FACULTY EMERITUS: J. O'Connor, D. Woods
ASSOCIATED FACULTY: S. Barton (HU), L. Elgert (DIGS), N. Heffernan (CS), K. Oates (BB), D. Rosbach (CEE)

DEPARTMENT DESCRIPTION

The Social Science and Policy Studies (SSPS) department offers students the opportunity to learn about human thought and behavior, politics, law, ethics, the environment, social justice, public policy, economics, and technology. Social Science disciplines investigate a variety of issues ranging from how stigma and stereotypes impact physical and mental health to the development of policies that impact individuals, groups, and organizations to understanding economic development and environmental degradation. Students learn to think critically about social issues and problems, particularly those that intersect with society technology, and develop skill sets that they can apply to their academic and professional careers. Students acquire tools to investigate problems using mixed-method research approaches such as laboratory studies experiments, in-depth field studies, interviews, large-scale data analysis, and survey data.

The department offers bachelor of science degrees, masters of science degrees, and Phds in a variety of social science disciplines that emphasize science and technology as a core aspect to the degrees. Students who choose a major in the SSPS department tend to be technologically inclined, but also desire to understand the connection society, people, politics, the environment, economics, psychology, and systems have to the STEM fields on a deeper level. We are committed to helping students at all levels to think critically about important societal problems and to identify effective solutions. WPI students who major or minor in social science disciplines go on to become professors, lawyers, economists, scientists, medical researchers, policy analysts, entrepreneurs, etc.

PROGRAMS

The Social Sciences and Policy Studies Department has two major programs and two minor programs. Our programs include Psychological and Cognitive Sciences, Technology, Policy, and Sustainability, and minor programs in Global Public Health and Africana Studies (with Humanities and Arts). The Technology, Policy and Sustainability Program offers a B.A. degree in Environmental and Sustainability Studies and B.S. degrees in Economic Science and Policy Studies. The Psychological and Cognitive Sciences program offers a B.S. in Psychological Science. The Department also serves as the home for the Law & Technology and System Dynamics minors. Given the diversity of our offerings , each program has a unique set of goals and outcomes. We also support the general education in the social sciences through the university wide two-course Social Science Requirement.

For additional advice about course selections, students should consult with their academic advisor. Detailed curriculum guidelines for each program as well as recommendations for completing the Social Science Requirement are available on the Social Science and Policy Studies Department website.

COURSE AREAS

The SSPS Department covers many of the traditional social science disciplines. Courses with the following prefixes are found in the Department:

DEV	Development
ECON	Economics
ENV	Environmental and Sustainability Studies
GOV	Political Science, Government, and Law
PSY	Psychology
SD	System Dynamics
SOC	Sociology
SS	General Social Science
STS	Society-Technology Studies

Double Major in Social Science and Policy Studies

Degree Type
Bachelor of Science

Any of the major programs offered by the SSPS Department may be taken as part of a double major in which the student majors in an area of science, engineering or business as well as social science. To obtain a double major, the student must satisfy all of the degree requirements of both majors, including the MQP and Distribution requirements. However, the MQP in the social science discipline may double count as the IQP, provided that the combined project meets the goals of both. It must be interactive in nature involving an aspect of technology as well as an application of social science knowledge and analytical techniques. Thus double majors for whom one of the majors is in the social sciences requires only two projects, not three. The decision to pursue the social science double major should be made fairly early in the student's academic career, certainly early enough to ensure the selection of an appropriate IQP/MQP.

UNDERGRADUATE RESEARCH OPPORTUNITIES

SSPS faculty are actively engaged in research in a variety of applied social science areas, with particular strength in economics, environmental studies, learning sciences, psychology, social and public policy, and system dynamics.

Minors in Social Science

Degree Type
Minor

A Social Science Minor is available in any of the following disciplines:

- Economics
- Sociology
- Political Science and Law
- System Dynamics
- Social Science

A minor in the Social Sciences consists of 2 units of academic activity satisfying the following conditions:

1. Foundations

Introductory level courses in any one or two of the following social science disciplines: economics (ECON), sociology (SOC), political science (and law) (GOV), and system dynamics (SD). Introductory courses are identified by the first digit of the course number, which must be a 1. The second digit of the course number indicates the discipline (1–economics, 2–sociology, 3–political science and law, and 5–system dynamics).

Introductory Economics (ECON) Courses

Item #	Title	Units
ECON 1110	Introductory Microeconomics	1/3
ECON 1120	Introductory Macroeconomics	1/3

Introductory Sociology (SOC) Courses

Item #	Title	Units
SOC 1202	Introduction to Sociology and Cultural Diversity	1/3

Introductory Political Science (and Law) (GOV) Courses

Item #	Title	Units
GOV 1301	U.S. Government	1/3
GOV 1303	American Public Policy	1/3
GOV 1310	Law, Courts, and Politics	1/3
GOV 1320	Topics in International Politics	1/3

Introductory System Dynamics (SD) Courses

Item #	Title	Units
SD 1510	Introduction to System Dynamics Modeling	1/3

2. Applied Courses (At least 1 unit)

Three or more higher level courses in the same social science discipline as the foundation courses, which involve applications or extensions of the material covered in the introductory courses and list the introductory courses as recommended background. High level courses have either a 2, 3, or 4 as the first digit of the course number. The capstone experience will consist of a paper in the last applied course taken. The paper must draw upon and integrate material covered in the previous courses. An IQP may provide the capstone experience and substitute for the last applied course provided that the IQP was advised or co-advised by a member of the Social Science & Policy Studies department, and contains appropriate social science analysis.

Higher-Level Economics (ECON) Courses

Item #	Title	Units
ECON 2110	Intermediate Microeconomics	1/3
ECON 2120	Intermediate Macroeconomics	1/3
ECON 2126	Public Economics	1/3
ECON 2130	Econometric Modeling	1/3
ECON 2135	Information Economics and Policy	1/3
ECON 2145	Behavioral Economics	1/3
ECON 2155	Experimental Economics	1/3
ECON 2910/ETR 2910	Economics and Entrepreneurship	1/3

Higher-Level Sociology (SOC) Courses

Higher-Level Political Science (and Law) (GOV) Courses

Item #	Title	Units
GOV 2302	Science-Technology Policy	1/3
GOV 2310	Constitutional Law: Foundations of Government	1/3
GOV 2311	Environmental Policy and Law	1/3
GOV 2313	Intellectual Property Law	1/3
GOV 2314/ID 2314	Cyberlaw and Policy	1/3
GOV 2315	Privacy: Laws, Policy, Technology, and How They Fit Together	1/3
GOV 2319/ENV 2319	Global Environmental Politics	1/3
GOV 2320	Constitutional Law: Civil Rights and Liberties	1/3
GOV 3000/PSY 3000	Psychology and Law	1/3
GOV 3312	International Environmental Policy	1/3

Higher-Level System Dynamics (SD) Courses

Item #	Title	Units
SD 2520	Modeling Economic and Social Systems	1/3
SD 2530	Advanced Topics in System Dynamics Modeling	1/3
SD 3550	System Dynamics Seminar	1/3

3. If five or more of the six 1/3 units required for the minor are in a single social science discipline, the title of the minor will be "Minor" in that discipline.*

Otherwise the title of the minor will be "Minor in Social Science." Examples of minor programs in economics, sociology, political science (and law), system dynamics and interdisciplinary social science are available at the SS & PS department office. The course selected for an interdisciplinary social science minor should follow an identifiable theme, such as the relationship between technology and society or social, political, economic or environmental policies.

Students taking minors in the social sciences are expected to designate a member of the SS & PS department as their SS minor advisor, who will assist them in preparing a program that meets the requirements of the minor. Students can obtain assistance at the SS & PS departmental office in designating an advisor.

Students completing any major in the Social Science and Policy Studies Department may not also complete a minor in social sciences.

* In designating sociology the minor, the course PSY 1402, Social Psychology, can be counted as one of the five courses required in Sociology.

In designating the economics minor, at least 3 of the 5 required courses must be chosen from among the following four theory courses

Item #	Title	Units
ECON 1110	Introductory Microeconomics	1/3
ECON 1120	Introductory Macroeconomics	1/3
ECON 2110	Intermediate Microeconomics	1/3
ECON 2120	Intermediate Macroeconomics	1/3

Business

D. JACKSON, DEAN, THE BUSINESS SCHOOL

D. STRONG, DEPARTMENT HEAD

S. DJAMASBI, PROGRAM DIRECTOR (MS IN INNOVATION WITH USER EXPERIENCE)

A. HALL-PHILLIPS, PROGRAM DIRECTOR (UNDERGRADUATE PROGRAMS)

S. JOHNSON, PROGRAM DIRECTOR (INDUSTRIAL ENGINEERING PROGRAM)

R. KONRAD, PROGRAM DIRECTOR (MS IN OPERATIONS AND SUPPLY CHAIN ANALYTICS PROGRAM)

J. RYAN, PROGRAM DIRECTOR (MS IN INFORMATION TECHNOLOGY & BUSINESS ANALYTICS PROGRAMS)

P. SHAH, PROGRAM DIRECTOR (MBA & MS IN MANAGEMENT PROGRAMS)

J. ZHU, PROGRAM DIRECTOR (PHD PROGRAM)

PROFESSORS: S. Djamasbi, M. Elmes, R. Garcia, S. Johnson, J. Sarkis, D. Strong, S. Taylor, B. Tulu, J. Zhu

ASSOCIATE PROFESSORS: A. Hall-Phillips, K. Dunbar, R. Konrad, E. Long Lingo, P. Shah, A. Trapp

ASSISTANT PROFESSORS: K. Ching, X. Gao, N. Kordzadeh, F. Reshadi, S. Saberi

PROFESSORS OF PRACTICE: D. Jackson, R. Sarnie

ASSOCIATE TEACHING PROFESSORS: J. Ryan, W. Towner, E.V. Wilson

ASSISTANT TEACHING PROFESSOR: J. Lindholm, D. Treku

EMERITUS FACULTY: M. Ginzberg, L. Graubard, F. Hoy, C. Kasouf, D. Klein, J. T. O'Connor, J. Schaufeld, S. Wulf

Mission

The WPI Business School develops adaptive leaders who create sustainable solutions, deliver globally responsible impact, and conduct transformative research at the intersection of business, technology, and people.

Vision

Bridging business and technology to develop globally responsible leaders who shape the world.

Course Areas

The School of Business covers all the functional areas of business. Courses with the following prefixes are found within the School:

ACC Accounting
BUS Business
ETR Entrepreneurship
FIN Finance
MIS Management Information Systems
MKT Marketing
OIE Operations & Industrial Engineering
OBC Organizational Behavior and Change

Business Major

Degree Type
Bachelor of Science

Educational Objectives

Objectives of the Business Major are:

- To prepare students for management roles in technology-based organizations.
- Through a flexible curriculum, to provide a solid, broad base of business knowledge and the written communication, oral presentation, decision-making, and leadership skills necessary to succeed in a technology-based environment.
- To develop student abilities necessary for continued career growth including:
    - the ability to integrate theory and practice;
    - the ability to integrate technology and change into existing organizations;
    - the ability to think critically and analytically, to define and solve business problems, work in teams, and think globally; and
    - the ability to learn new skills in response to changing professional requirements.

Program Distribution Requirements for the Business Major

Mathematics and Science

Mathematics (4/3 units)

Mathematics must include 2/3 units of calculus and 2/3 units of statistics.

Item #	Title	Units
MA 1021	Calculus I	1/3
MA 1022	Calculus II	1/3
MA 2611	Applied Statistics I	1/3
MA 2612	Applied Statistics II	1/3

Computer Science (1/3 unit)

A minimum of 1/3 unit of Computer Science focused on programming.
CS 1004, CS 1101, or CS 1102 is recommended. (CS 2022 and CS 3043 are not accepted.)

Item #	Title	Units
CS 1004	Introduction to Programming for Non-Majors	1/3
CS 1101	Introduction to Program Design	1/3
CS 1102	Accelerated Introduction to Program Design	1/3

Basic Science (2/3 unit)

Biology, Chemistry, Geology, Physics

Business Core Curriculum

Business Foundation (11/3 units)

Item #	Title	Units
	ECON 1110 or ECON 1120 or ECON 2910/ETR 2910	1/3
	ID 2050 or one from DEV, ECON, ENV, GOV, PSY, SD, SOC, SS, STS	1/3
OBC 1010	Leadership Practice	1/3
BUS 1020	Global Environment of Business Decisions	1/3
BUS 2020	The Legal Environment of Business Decisions	1/3
ACC 2060	Financial Statements for Decision Making	1/3
BUS 2080	Data Analysis for Decision Making	1/3
FIN 2070	Risk Analysis for Decision Making	1/3
MIS 3010	Creating Value Through Innovation	1/3
MKT 4030	Achieving Strategic Effectiveness	1/3
OIE 3020	Achieving Effective Operations	1/3

ECON 1110 or 1120 or 2910 and ID 2050 or one from DEV, ECON, ENV, GOV, PSY, SD, SOC, SS, STS are required and also fulfill the WPI Social Science requirement.

Business Major Concentrations (6/3 unit)

Students selecting the Business Major must complete six courses from one of the concentrations as specified in the summary table for concentrations. Students may also work with their academic advisor to create a custom BU Program. Such custom programs must be approved by the advisor and the Business School's Undergraduate Policy and Curriculum Committee.

BS in Business Concentrations:

- Business Analytics
- Financial Technology (FinTech)
- Innovation for Social Change
- General Business

See concentration links above for more information.

Breadth Electives (3/3 unit)

Breadth Electives must include at least 1/3 unit from among the 3000- and 4000-level courses in the Business department. The remaining 2/3 units specified in the requirement may be satisfied with courses from Mathematics, Basic Science, Computer Science, Data Science, Social Science (except ID/SS 2050), or courses with any of the following prefixes: ACC, BUS, ETR, FIN, MIS, MKT, OBC, or OIE.

Major Qualifying Project (3/3 Units)

The MQP must have a focus in the concentration area with an MQP advisor from the Business School.

Free Electives (5/3 units)

Financial Technology Major

Degree Type
Bachelor of Science

Financial Technology (FT) Educational Objectives

- Key technologies of the FinTech industry, including artificial intelligence (AI) & machine learning (ML) & natural language processing (NPL), blockchain & cryptocurrency, and smart contracts.
- Relevant programming skills.
- Recent innovations in the financial services industry, including payment, credit, capital markets, insurance, and real estate.
- The limitations and challenges of FinTech (e.g., inclusion, regulation).
- Emerging areas for entrepreneurial opportunities in the FinTech sector
- The operational and strategic goals of financial institutions and intermediaries, and how technology is reshaping not only the traditional areas of finance (e.g., alternative lending ("alt- finance")) and wealth management but also in related fields such as insurance ("Insur-tech") and real estate.
- The information and communication tools, technologies, and standards integral to consumer, merchant, and enterprise services in the payments and financial service sectors. These technologies span messaging, communication networks and gateways, core processing, mobile and online software, and application program interfaces (APIs).
- The basic legal frameworks of the U.S. banking and securities sectors, how new technologies ("FinTech") are transforming legacy banking and securities business models, and how new information technologies may be able to deliver financial services to communities historically excluded from the banking and/or securities sectors.

Program Distribution Requirements for the Financial Technology Major

Mathematics and Science

Mathematics

Calculus (2/3 Units)

Item #	Title	Units
MA 1021	Calculus I	1/3
MA 1022	Calculus II	1/3

Statistics (2/3 Units)

Item #	Title	Units
MA 2611	Applied Statistics I	1/3
MA 2612	Applied Statistics II	1/3
	MA 2071 or MA 2072 or MA 2073	

Selection one from the courses below (1/3 Units)

Item #	Title	Units
MA 2071	Matrices and Linear Algebra I	1/3
MA 2072	Accelerated Matrices and Linear Algebra I	1/3
MA 2073	Matrices and Linear Algebra II	1/3

Computer Science (1/3 Units)

CS 1004, CS 1101, CS 1102 recommended.

Excluding: CS 2022 and CS 3043

Item #	Title	Units
CS 1004	Introduction to Programming for Non-Majors	1/3
CS 1101	Introduction to Program Design	1/3
CS 1102	Accelerated Introduction to Program Design	1/3

Basic Science (2/3 Units)

2/3 units of Science coursework from BB, CH, GE, or PH.

Social Science (2/3 Units)

ECON 1110 and ECON 1120 required.

Item #	Title	Units
ECON 1110	Introductory Microeconomics	1/3
ECON 1120	Introductory Macroeconomics	1/3

Financial Technology Curriculum

Business Foundation Courses (4/3 Units)

Item #	Title	Units
ACC 2060	Financial Statements for Decision Making	1/3
BUS 2020	The Legal Environment of Business Decisions	1/3
FIN 2070	Risk Analysis for Decision Making	1/3
OBC 3354	Organizational Behavior and Change	1/3

FinTech Foundation Courses (3/3 Unit)

Item #	Title	Units
FIN 3300	Finance & Technology (FinTech)	1/3
FIN 3310	Financial Markets and Digital Currencies	1/3

Technical Courses (3/3 Unit)

Item #	Title	Units
MIS 2300	Business Applications of Blockchain	1/3
MIS 3730	Artificial Intelligence with Business Application	1/3
MIS 3787	Business Applications of Machine Learning	1/3

Analytical Courses (3/3 Unit)

Item #	Title	Units
BUS 2080	Data Analysis for Decision Making	1/3
MIS 4084	Business Intelligence	1/3
OIE 3510	Stochastic Models	1/3

Financial Technology Concentrations (6/3 units)

Students selecting the Financial Technology Major must complete six courses from one of the concentrations as specified in the summary table for concentrations.

BS in Financial Technology Concentrations:

- Financial Analytics
- Financial Mathematics
- Financial Technologies
- General

See concentration links above for more information.

Major Qualifying Project (3/3 units)

MQP must have a business focus related to FinTech.

Free Electives (3/3 units)

Industrial Engineering Major

Degree Type
Bachelor of Science

Program Mission

The mission of the Industrial Engineering (IE) Program at WPI is to prepare undergraduate students for professional engineering practice, providing the foundation for careers of leadership in challenging global and technological environments. We strive to accomplish this through:

- An innovative, project-based curriculum
- An emphasis on industrial engineering skills with system applications
- A flexible curriculum responsive to student interests and changes in the competitive environment
- An environment that encourages faculty/student interaction
- A culture that encourages the active involvement of students in their learning

Program Educational Objectives

The educational objectives of the IE Program describe the expected accomplishments of graduates during the first few years after graduation. They include:

Industrial Engineering Knowledge and Design Skills. Graduates should be able to support operational decision-making and to design solutions that address the complex and changing industrial engineering problems faced by organizations, using current concepts and technologies.

Communication Skills. Graduates will be sought out as the preferred employees to represent their companies both for internal and external communications based upon the excellence they will have achieved through persistent updating of their knowledge of new communication tools and by taking advantage of opportunities for critical peer review.

Teamwork and Leadership Skills. Graduates should be able to serve as change agents in a global environment, based on strong interpersonal and teamwork skills, an understanding of professional and ethical responsibility, and a willingness to take initiatives.

Student Outcomes

Specifically, graduating students should demonstrate that they attain the following:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Program Distribution Requirements for the Industrial Engineering Major

The normal period of residency at WPI is 16 terms. In addition to the WPI requirements applicable to all students (see page 7), students wishing to receive the ABET accredited degree designated “Industrial Engineering” must complete a minimum of 10 units of study in the areas of mathematics, basic science, and engineering topics as follows:

Mathematics and Science Requirements

No GPS credits may be used.

Mathematics (7/3 Units)

Item #	Title	Units
MA 1021	Calculus I	1/3
MA 1022	Calculus II	1/3
MA 1023	Calculus III	1/3
MA 1024	Calculus IV	1/3
MA 2051	Ordinary Differential Equations	1/3
MA 2611	Applied Statistics I	1/3
MA 2612	Applied Statistics II	1/3
MA 2621	Probability for Applications	1/3

Physics/Chemistry (3/3 Units)

One Chemistry course and one Physics course required; plus one additional Chemistry or Physics course.

Math and Science electives (2/3 units)

Recommended Math: MA 2071, probability & statistics, numerical analysis.

Recommended Science: BB, CH, GE, PH

Social Sciences (2/3 units)

ID 2050 and one from DEV, ECON, ENV, GOV, PSY, SD, SOC, SS, STS.

Item #	Title	Units
	One from DEV, ECON, ENV, GOV, PSY, SD, SOC, SS, STS	

Industrial Engineering Topics (15/3 units)

Industrial Engineering Topics must include courses in the following three topic areas

Industrial Engineering Core courses (9/3 units)

Item #	Title	Units
OIE 2081	Introduction to Prescriptive Analytics	1/3
	OIE 2600 or CS 2119 or CS 2102 or 2103	
OIE 2850	Engineering Economics	1/3
OIE 3020	Achieving Effective Operations	1/3
	OIE 3405 or OIE 4430	
OIE 3410	Materials Management in Supply Chains	1/3
OIE 3420	Quality Planning, Design and Control	1/3
OIE 3460	Simulation Modeling and Analysis	1/3
OIE 3510	Stochastic Models	1/3

Industrial Engineering Electives (3/3 units)

Any 3000- or 4000-level Operations Research courses in MA; MIS 3720, 3787, 4084, 4720, 4741; OIE 2600*, 3405*, 4410, 4430*, 4460.

*Only if not taken in core.

Item #	Title	Units
OIE 2600	Scripting for Process and Productivity Improvement	1/3
OIE 3405	Work Systems and Facilities Planning	1/3
OIE 4410	Case Studies in Industrial Engineering	1/3
OIE 4430	Advanced Prescriptive Analytics: From Data to Impact	1/3
OIE 4460	Global Planning and Logistics	1/3
MIS 3720	Business Data Management	1/3
MIS 3787	Business Applications of Machine Learning	1/3
MIS 4720	Systems Analysis and Design	1/3
MIS 4741	User Experience and Design	1/3
MA 3231	Linear Programming	1/3
MA 3233	Discrete Optimization	1/3
MA 3627	Introduction to the Design and Analysis of Experiments	1/3
MA 3631	Mathematical Statistics	1/3
MA 4235	Mathematical Optimization	1/3
MA 4237	Probabilistic Methods in Operations Research	1/3
MA 4631	Probability and Mathematical Statistics I	1/3
MA 4632	Probability and Mathematical Statistics II	1/3

Technical Electives (3/3 units)

Any designated CE (except CE 3022), CHE, CS (except CS 1004, 1101, 1102, 3043), ECE, ES (except ES 1000, 3323), ME, OIE, RBE, as well as any IE Elective (see above). One ES course required. GPS course credits do not qualify.

Suggested courses:

Item #	Title	Units
CS 2011	Introduction to Machine Organization and Assembly Language	1/3
CS 4032/MA 3257	Numerical Methods for Linear and Nonlinear Systems	1/3
ECE 2010	Introduction to Electrical and Computer Engineering	1/3
ES 1310	Introduction to Computer Aided Design	1/3
ES 2001	Introduction to Materials Science	1/3
ES 2800	Environmental Impacts of Engineering Decisions	1/3
ES 3001	Introduction to Thermodynamics	1/3
ME 1800	Manufacturing Science, Prototyping, and Computer-Controlled Machining	1/3
ME 2820	Materials Processing	1/3

Capstone Design Experience (IE MQP) (3/3 unit)

The MQP must have an IE faculty advisor from the Business School.

Free Electives (3/3 units)

Program Chart and/or Course Flow Chart

INDUSTRIAL ENGINEERING
OVERVIEW OF DEGREE REQUIREMENTS

UNIVERSITY REQUIREMENTS
HUMANITIES AND ARTS (6/3 Units): 6 courses including Inquiry Seminar/Practicum
SOCIAL SCIENCE (2/3 Units): ECON, ENV, GOV, SOC, SS, STS, and ID 2050
PHYSICAL EDUCATION (1/3 Units)
INTERACTIVE QUALIFYING PROJECT (3/3 Unit)-3rd Year

MATHEMATICS AND SCIENCE REQUIREMENTS
MATHEMATICS (7/3 Units) Calculus - MA 1021; MA 1022; MA 1023, MA 1024, MA 2051 Statistics - MA 2611; MA 2612 or 2621
PHYSICS/CHEMISTRY (3/3 Units) CH, PH, CH or PH
MATH/SCIENCE ELECTIVES (2/3 Units) Recommended Math: MA 2071, probability & stats., numerical analysis Science BB, CH, GE, PH

INDUSTRIAL ENGINEERING CORE CURRICULUM (9/3 Units)	
OIE 2081 Introduction to Prescriptive Analytics	OIE 3405 Work Systems and Facilities Planning **or** OIE 4430 Advanced Prescriptive Analytics: From Data to Impact
OIE 2600 Scripting for Process & Productivity Improvement **or** CS 2119 **or** CS 2102 **or** CS 2103	OIE 3410 Materials Management in Supply Chains
OIE 2850 Engineering Economics	OIE 3420 Quality Planning, Design and Control
OIE 3020 Achieving Effective Operations	OIE 3460 Simulation Modeling and Analysis
	OIE 3510 Stochastic Models

INDUSTRIAL ENGINEERING ELECTIVES-Operations Research (3/3 Units)
Choose three: OIE 2600*, OIE 3405*, OIE 4410, OIE 4430*, OIE 4460, MIS 3720, MIS 3787, MIS 4084, MIS 4720, MIS 4741, MA 3231, MA 3233, MA 3627, MA 3631, MA 4235, MA 4237, MA 4631, MA 4632. **Only if not taken in IE Core.*

TECHNICAL ELECTIVES (3/3 Units)
Any designated CE (except CE 3022), CHE, CS (except CS 1004, 1101, 1102, 3043), ECE, ES (except ES 1000, 3323), ME, OIE, RBE, as well as any IE Elective (see above). Suggested courses include: CS 2011, CS 4032/MA 3257, ECE 2010, ES 1310, ES 2001, ES 2800, ES 3001, ME 1800, ME 2820. ***One ES course required.*** *GPS course credits do not qualify.*

MAJOR QUALIFYING PROJECT (3/3 Units)
The MQP must have an IE faculty advisor from the Business School.

FREE ELECTIVES (3/3 Units)

Management Engineering Major

Degree Type

Bachelor of Science

Educational Objectives

Objectives of the Management Engineering Major are:

- To prepare students for management challenges in key areas that increasingly require proficiency in the technical aspects of business such as production and service operations.
- To provide the knowledge and skills necessary to succeed professionally, including literacy in a technical field, a broad understanding of management issues, written communication, oral presentation, decision-making, and leadership skills required to create new and improved products, processes and control systems.
- To develop student abilities necessary for continued career growth including:
    - the ability to integrate theory and practice and to apply knowledge of technical issues with the foundations of management
    - the ability to integrate technology and change into existing organizations
    - the ability to think critically and analytically, to define and solve business problems, work in teams, and think globally; and
    - the ability to learn new skills in response to changing professional requirements.

Program Distribution Requirements for the Management Engineering Major

Mathematics and Science

Mathematics (4/3 units)

Mathematics must include 2/3 units of calculus and 2/3 units of statistics.

Item #	Title	Units
MA 1021	Calculus I	1/3
MA 1022	Calculus II	1/3
MA 2611	Applied Statistics I	1/3
MA 2612	Applied Statistics II	1/3

Computer Science (1/3 unit)

A minimum of 1/3 unit of Computer Science focused on programming. CS 1004, CS 1101, or CS 1102 is recommended. (CS 2022 and CS 3043 are not accepted.)

Item #	Title	Units
CS 1004	Introduction to Programming for Non-Majors	1/3
CS 1101	Introduction to Program Design	1/3
CS 1102	Accelerated Introduction to Program Design	1/3

Basic Science (2/3 unit)

Any course with prefix: BB, CH, GE, PH

Social Sciences (2/3 units)

ECON 1110 or ECON 1120 or ECON 2910/ETR 2910 and

ID 2050 or one from DEV, ECON, ENV, GOV, PSY, SD, SOC, SS, STS

Item #	Title	Units
	ECON 1110 or ECON 1120 or ECON 2910/ETR 2910	1/3
	ID 2050 or one from DEV, ECON, ENV, GOV, PSY, SD, SOC, SS, STS	1/3

Management Engineering Core Curriculum

Financial Courses (3/3 unit)*

ACC 2060: Financial Statements for Decision Making; Select one course from: FIN 1250 Personal Finance, FIN 2070 Fundamentals of Finance, FIN 3300 Finance & Technology (FinTech); OIE 2850 Engineering Economics.

*Two courses at 3,000 level or above required across Financial and Managerial courses.

Item #	Title	Units
ACC 2060	Financial Statements for Decision Making	1/3
	FIN 1250 or FIN 2070 or FIN 3300	
OIE 2850	Engineering Economics	1/3

Managerial Courses (3/3 unit)*

Select one organizational behavior course (Recommended OBC 1010 Leadership Practice); Select one marketing course (Recommended MKT 4030 Achieving Strategic Effectiveness); Select one course from BUS 2020 The Legal Environment of Business Decisions, MIS 3010 Creating Value through Innovation, any course with an ETR, MKT, or OBC prefix.

*Two courses at 3,000 level or above required across Financial and Managerial courses.

Item #	Title	Units
OBC 1010	Leadership Practice	1/3
MKT 4030	Achieving Strategic Effectiveness	1/3
	BUS 2020 or MIS 3010, ETR, MKT, OBC course	1/3

Technical Courses (3/3 unit)

OIE 3020 Achieving Effective Operations; Select two courses from the following: AE, BB, BME, CE (except 3022), CH, CHE, CS (except 3043), DS, ECE, ES (except 1000), GE, OIE, MA, ME, PH, RBE (except 3100).

Item #	Title	Units
OIE 3020	Achieving Effective Operations	1/3
	Select two courses from the following: AE, BB, BME, CE (except 3022), CH, CHE, CS (except 3043), DS, ECE, ES (except 1000), GE, OIE, MA, ME, PH, RBE (except 3100)	2/3

Analytics Courses (3/3 unit)

OIE 3420 Quality Planning Design and Control; Select one course from: MIS 3720 Business Data Management, MIS 3787 Business Applications of Machine Learning, MIS 4084 Business Intelligence; Select one course from: BUS 2080 Data Analysis for Decision Making or OIE 2081 Introduction to Prescriptive Analytics, OIE 3460 Simulation Modeling and Analysis, OIE 3510 Stochastic Models, OIE 4430 Advanced Prescriptive Analytics: From Data to Impact.

Item #	Title	Units
OIE 3420	Quality Planning, Design and Control	1/3
	MIS 3720 or MIS 3787 or MIS 4084	1/3
	BUS 2080, OIE 2081, OIE 3460, OIE 3510, OIE 4430	1/3

Technical or Analytics Course (1/3 unit)

Select one additional course from remaining Technical or Analytics Courses.

Management Engineering Concentrations (6/3 Units)

Students selecting the Management Engineering Major must complete six courses from one of the concentrations as specified in the summary table for concentrations. Students may also work with their faculty advisor to create a custom MGE Program. Such custom programs must be approved by the advisor and the Business School's Undergraduate Policy and Curriculum Committee.

BS in Management Engineering Concentrations:

- Biomedical Engineering
- Civil Engineering
- Electrical and Computer Engineering
- Industrial Engineering
- Information Technology
- Manufacturing Engineering
- Mechanical Engineering
- Custom

See concentration links above for more information.

Major Qualifying Project (3/3 units)

The MQP must have a focus in the concentration area with an MQP advisor from the Business School.

Free Electives (4/3 Units)

Management Information Systems Major

Degree Type

Bachelor of Science

Educational Objectives

The objectives of the Management Information Systems major are:

• To prepare students for positions involving the design and deployment of business applications using a wide variety of advanced information technologies, especially in high technology business, consulting, and service firms, in either start-up or established environments, and to prepare students for rapid advancement to project management and other management positions.

• To provide the knowledge and skills consistent with the professionally accepted IS curriculum guidelines. Specifically, this includes providing knowledge and skills related to:

- business application development tools;
- database, web-based and machine learning applications;
- integrating IT into existing organizations through managing and leading systems analysis and design projects;
- communicating effectively via written and oral presentations.

• To develop student abilities necessary for continued career growth including:

- the ability to integrate theory and practice and to apply knowledge of information technology issues with the foundations of management;
- the ability to integrate technology and change into existing organizations;
- the ability to think critically and analytically, to define and solve business problems, work in teams, and think globally; and
- the ability to learn new skills in response to changing professional requirements.

Program Distribution Requirements for the Management Information Systems Major

Mathematics and Science

Mathematics (4/3 units)

Mathematics must include 2/3 units of calculus and 2/3 units of statistics.

Item #	Title	Units
MA 1021	Calculus I	1/3
MA 1022	Calculus II	1/3
MA 2611	Applied Statistics I	1/3
MA 2612	Applied Statistics II	1/3

Computer Science (1/3 unit)

A minimum of 1/3 unit of Computer Science focused on programming.
CS 1004, CS 1101, or CS 1102 is recommended. (CS 2022 and CS 3043 are not accepted.)

Item #	Title	Units
CS 1004	Introduction to Programming for Non-Majors	1/3
CS 1101	Introduction to Program Design	1/3
CS 1102	Accelerated Introduction to Program Design	1/3

Basic Science (2/3 unit)

Biology, Chemistry, Geology, Physics

Business Core Curriculum

Business Foundation (11/3 units)

Item #	Title	Units
	ECON 1110 or ECON 1120 or ECON 2910/ETR 2910	1/3
	ID 2050 or one from DEV, ECON, ENV, GOV, PSY, SD, SOC, SS, STS	1/3
OBC 1010	Leadership Practice	1/3
BUS 1020	Global Environment of Business Decisions	1/3
BUS 2020	The Legal Environment of Business Decisions	1/3
ACC 2060	Financial Statements for Decision Making	1/3
BUS 2080	Data Analysis for Decision Making	1/3
FIN 2070	Risk Analysis for Decision Making	1/3
MIS 3010	Creating Value Through Innovation	1/3
MKT 4030	Achieving Strategic Effectiveness	1/3
OIE 3020	Achieving Effective Operations	1/3

ECON 1110 or ECON 1120 or ECON/ETR 2910 and ID 2050 or one from DEV, ECON, ENV, GOV, PSY, SD, SOC, SS, STS fulfill the WPI Social Science requirement.

Management Information Systems (6/3 unit)

Complete the following four: (CS 2119 or CS 2102 or CS 2103), MIS 3720, MIS 3787, MS 4720

Item #	Title	Units
	CS 2119 or CS 2102 or CS 2103	
MIS 3720	Business Data Management	1/3
MIS 3787	Business Applications of Machine Learning	1/3
MIS 4720	Systems Analysis and Design	1/3

Select two courses from: (CS 2102 or CS 2103), (CS 2301 or CS 2303) CS 3041, DS 1010, MIS 4084, MIS 4741

Item #	Title	Units
MIS 4084	Business Intelligence	1/3
MIS 4741	User Experience and Design	1/3
	CS 2102 or CS 2103	
	CS 2301 or CS 2303	1/3
CS 3041	Human-Computer Interaction	1/3
DS 1010	Data Science I: Introduction to Data Science	1/3

Breadth Electives (3/3 unit)

Breadth Electives must include at least 1/3 unit from among the 3000- and 4000-level courses in the Business department. The remaining 2/3 units specified in the requirement may be satisfied with courses from Mathematics, Basic Science, Computer Science, Data Science, Social Science (except ID/SS 2050), or courses with any of the following prefixes: ACC, BUS, ETR, FIN, MIS, MKT, OBC, or OIE.

Major Qualifying Project (3/3 Units)

The MQP must have a focus in the concentration area with an MQP advisor from the Business School.

Free Electives

Program Chart and/or Course Flow Chart

MANAGEMENT INFORMATION SYSTEMS
OVERVIEW OF DEGREE REQUIREMENTS

UNIVERSITY REQUIREMENTS
HUMANITIES AND ARTS (6/3 Units): 6 courses including Inquiry Seminar/Practicum
SOCIAL SCIENCE (2/3 Units): ECON 1110 or 1120 or 2910* One from DEV, ECON, ENV, GOV, PSY, SD, SOC, SS, STS or ID 2050*
PHYSICAL EDUCATION (1/3 Units)
INTERACTIVE QUALIFYING PROJECT (3/3 Unit)-3rd Year

MATHEMATICS AND SCIENCE REQUIREMENTS
BASIC SCIENCE (2/3 Units) BB, CH, GE, PH
MATHEMATICS (4/3 Units) Calculus - MA 1021; MA 1022; Statistics - MA 2611; MA 2612
COMPUTER SCIENCE (1/3 Units): CS 1004 (recommended) or CS 1101 or CS 1102

CORE BUSINESS CURRICULUM	
BUSINESS FOUNDATION (5/3 Units) 1. ECON 1110 Introductory Microeconomics ***or*** 1120 Introductory Macroeconomics ***or*** 2910 Economics and Entrepreneurship* 2. One from DEV, ECON, ENV, GOV, PSY, SD, SOC, SS, STS or ID 2050* 3. BUS 1020 Global Environment of Decision Making 4. BUS 2020 Legal Environment of Business Decisions 5. OBC 1010 Leadership Practice	**BUSINESS STRATEGY AND ANALYSIS (6/3 Units)** 6. ACC 2060 Financial Statements for Decision Making 7. BUS 2080 Data Analysis for Decision Making 8. FIN 2070 Risk Analysis for Decision Making 9. MIS 3010 Creating Value Through Innovation 10. MKT 4030 Achieving Strategic Effectiveness 11. OIE 3020 Achieving Effective Operations

MIS CONCENTRATION (6/3 Units)	
1. CS 2119 Application Building with Object-Oriented Concepts ***or*** CS 2102 Object-Oriented Design Concepts ***or*** CS 2103 Accelerated Object-Oriented Design Concepts 2. MIS 3720 Business Data Management 3. MIS 3787 Business Applications of Machine Learning 4. MIS 4720 Systems Analysis and Design	**Select two from:** MIS 4084 Business Intelligence, MIS 4741 User Experience and Design, CS 2102 Object-Oriented Design Concepts ***or*** CS 2103 Accelerated Object-Oriented Design Concepts, CS 2301 Systems Programming for Non-Majors ***or*** CS 2303 Systems Programming Concepts, CS 3041 Human-Computer Interaction, DS 1010 Data Science I: Introduction to Data Science
MAJOR QUALIFYING PROJECT (3/3 Units) **The MQP must have a focus in the concentration area with an MQP advisor from the Business School.**	

BREADTH ELECTIVES (3/3 Units)
Breadth Electives must include at least 1/3 unit from 3,000- or 4000-level courses with any of the following prefixes: ACC, BUS, ETR, FIN, MIS, MKT, OBC, OIE. The remaining 2/3 units specified in the requirement may be satisfied with courses from Mathematics, Basic Science, Computer Science, Data Science, Social Science (except ID/SS 2050), or courses with any of the following prefixes: ACC, BUS, ETR, FIN, MIS, MKT, OBC, or OIE.

FREE ELECTIVES (5/3 Units)

*Counts toward (2/3 Units) Social Science requirement.

Business Minor

Degree Type

Minor

Everyone needs management skills. If engineers, scientists, and others hope to advance in their careers, they must learn how to lead projects and manage groups. The Business minor offers students (other than BU, MGE, or MIS majors, who may take the courses as part of their major or as Breadth or Free Electives, as appropriate) the opportunity to learn some of the theory and practice of managing in organizations with material on management concepts and practices commonly encountered in the business world. This program will help students make a transition to the business world and will provide basic skills for operating effectively in business organizations.

The minor in Business is available to all students at WPI, except for those majoring in Business, Management Engineering or Management Information Systems majors at WPI.

To complete the Business minor, a student must complete two units of work, typically through course work with the following distribution:

Program Distribution Requirements for the Business Minor

Select any five from the following:

Item #	Title	Units
	ECON 1110 or ECON 1120	1/3
	OBC 1010 or OBC 4367	
BUS 1020	Global Environment of Business Decisions	1/3
BUS 2020	The Legal Environment of Business Decisions	1/3
ACC 2060	Financial Statements for Decision Making	1/3
	FIN 2070 or FIN 3300	
BUS 2080	Data Analysis for Decision Making	1/3
	MIS 3010 or MIS 4084	
OIE 3020	Achieving Effective Operations	1/3
	FIN 1250 or OIE 2850	

Select one of the following two courses:

Item #	Title	Units
MKT 4030	Achieving Strategic Effectiveness	1/3
ETR 4930	Growing and Managing New Ventures	1/3

Entrepreneurship Minor

Degree Type
Minor

All around the world people are starting their own new business ventures. With its strong heritage of invention and entrepreneurship among students and faculty members, WPI is committed to encouraging its students to consider that career path. Our dream is that our students will earn a minor in Entrepreneurship, which will provide them with some basic business skills and an understanding of what it takes to start a business, then they will create a new and exciting technology as their MQP that they will then turn into a business upon graduation.

The minor in Entrepreneurship is available to all students at WPI, regardless of major.

Related opportunities include competitions for the following: The Robert H. Grant Invention Awards, the Strage Innovation Awards, and the Kalenian Award. Through the Collaborative for Entrepreneurship and Innovation, WPI sponsors the student entrepreneurship club, Tech Entrepreneurs, and promotes and sponsors MassChallenge.

The minor requires the completion of two units of coursework as noted below.

Program Distribution Requirements for the Entrepreneurship Minor

Complete the following course:

Item #	Title	Units
ACC 2060	Financial Statements for Decision Making	1/3

Complete two (2) from the following list:

Item #	Title	Units
ETR 1100	Engineering Innovation and Entrepreneurship	1/3
ETR 2900	Social Entrepreneurship	1/3
ETR 3633	Entrepreneurial Selling	1/3
ETR 3915	Entrepreneurial Business Models	1/3
OBC 4367	Leadership, Ethics, and Social Responsibility	1/3

Complete two (2) of the following courses:

Item #	Title	Units
FIN 2070	Risk Analysis for Decision Making	1/3
GOV 2313	Intellectual Property Law	1/3
ENV 2600	Environmental Problems in the Developing World	1/3
MIS 3010	Creating Value Through Innovation	1/3
MKT 3640	Management of Process and Product Innovation	1/3

Required:

Item #	Title	Units
ETR 4930	Growing and Managing New Ventures	1/3

Financial Technology Minor

Degree Type
Minor

The Financial Technology (FinTech) minor is designed for students interested in doing an MQP with the Wall St. project center and/or pursuing a career in the financial technology industry, but are not seeking a B.S. in Business with a concentration in FinTech. The financial technology industry and the Wall St. project center are seeking students with technical degrees, e.g., in CS, ECE, IE, MA, but those students also should have some financial and business background. This minor provides that background. It is open to all students, except those seeking a B.S. in Business with a concentration in FinTech.

Recommended background: Ideally, students enrolling in this minor have some knowledge of programming (equivalent to 2/3 units from CS 1004, CS 1101/1102, CS 2102/2103, CS 2119), statistics and/or probability (equivalent to 2/3 units from MA 2611, MA 2612, MA 2621), and differential and integral calculus (equivalent to 2/3 units from MA 1020/1021, MA 1022). Most WPI students will have such background as part of their distribution requirements in technical majors.

Successful candidates for the FinTech Minor must meet the following requirements:

Program Distribution Requirements for the FinTech Minor

Select three courses in accounting and finance:

Item #	Title	Units
ACC 2060	Financial Statements for Decision Making	1/3
FIN 2070	Risk Analysis for Decision Making	1/3
FIN 3300	Finance & Technology (FinTech)	1/3

Select one course in database technology:

Item #	Title	Units
CS 3431	Database Systems I	1/3
MIS 3720	Business Data Management	1/3

Select one FinTech related elective:

Item #	Title	Units
	Business Courses	
	Advanced Computer Science Courses	
	Data Science Courses	
	Economics Courses	
	Advanced Mathematics Courses	

Select one integrating capstone course:

Item #	Title	Units
CS 3733	Software Engineering	1/3
MIS 4720	Systems Analysis and Design	1/3

Industrial Engineering Minor

Degree Type
Minor

Industrial Engineering is concerned with efficiency and process improvement, which are vital to any organization's survival and growth in a global, competitive world. Hence, the fundamental skills and knowledge of Industrial Engineering can be utilized in many areas, and are valuable supplements to a student's core competency in his/her chosen major discipline. The IE minor provides an easy link between the curricula in engineering and business and expands students' ability to tackle business decisions and problems using engineering techniques.

The minor in Industrial Engineering is available to all students at WPI, except for those majoring in Industrial Engineering.

The minor requires the completion of two units of coursework (six courses) as noted below.

Program Distribution Requirements for the Industrial Engineering Minor

IE Tools, select at least two (2):

Item #	Title	Units
OIE 2081	Introduction to Prescriptive Analytics	1/3
OIE 2600	Scripting for Process and Productivity Improvement	1/3
OIE 2850	Engineering Economics	1/3
OIE 3460	Simulation Modeling and Analysis	1/3
OIE 3510	Stochastic Models	1/3
OIE 4430	Advanced Prescriptive Analytics: From Data to Impact	1/3

IE Knowledge, select at least two (2):

Item #	Title	Units
OIE 3020	Achieving Effective Operations	1/3
OIE 3405	Work Systems and Facilities Planning	1/3
OIE 3410	Materials Management in Supply Chains	1/3
OIE 3420	Quality Planning, Design and Control	1/3
OIE 4410	Case Studies in Industrial Engineering	1/3
OIE 4460	Global Planning and Logistics	1/3

Management Information Systems Minor

Degree Type

Minor

Information technology has been the driving force behind the new way of doing business. It has enabled companies to make tremendous strides in productivity, it has opened new markets and new channels, and it has created new product and service opportunities. While one part of the information revolution has been advances in hardware, and another has been advances in software, a third major advance has been in the systems-side of information, or how information is organized and used to make effective decisions. That is Management Information Systems (MIS). The minor in MIS offers students the opportunity to broaden their disciplinary program with material and skills widely useful in the business world. This program will help students to broaden their exposure to information technology and its use in business and industry.

The minor Management Information Systems is available to all students at WPI, except for those majoring in Management Information Systems.

Program Distribution Requirements for the Management Information Systems Minor

Select three courses in Business Foundation and Programming Skills, with at least one from each group:

Business Foundation:

Item #	Title	Units
OBC 1010	Leadership Practice	1/3
BUS 1020	Global Environment of Business Decisions	1/3
BUS 2020	The Legal Environment of Business Decisions	1/3
ACC 2060	Financial Statements for Decision Making	1/3
FIN 2070	Risk Analysis for Decision Making	1/3
BUS 2080	Data Analysis for Decision Making	1/3
MIS 3010	Creating Value Through Innovation	1/3
OIE 3020	Achieving Effective Operations	1/3
MKT 4030	Achieving Strategic Effectiveness	1/3

Programming Skills:

Item #	Title	Units
	CS 1004 or CS 1101 or CS 1102	
	CS 2102 or CS 2103	
CS 2119	Application Building with Object-Oriented Concepts	1/3
	CS 2301 or CS 2303	1/3

Select two courses:

Item #	Title	Units
MIS 3720	Business Data Management	1/3
MIS 3787	Business Applications of Machine Learning	1/3
MIS 4084	Business Intelligence	1/3
MIS 4741	User Experience and Design	1/3

Required Course:

Item #	Title	Units
MIS 4720	Systems Analysis and Design	1/3

Business Major with Concentration in Business Analytics

Degree Type

Concentration

Educational Objectives

Objectives of the Business Major are:

- To prepare students for management roles in technology-based organizations.
- Through a flexible curriculum, to provide a solid, broad base of business knowledge and the written communication, oral presentation, decision-making, and leadership skills necessary to succeed in a technology-based environment.
- To develop student abilities necessary for continued career growth including:
    - the ability to integrate theory and practice;
    - the ability to integrate technology and change into existing organizations;
    - the ability to think critically and analytically, to define and solve business problems, work in teams, and think globally; and
    - the ability to learn new skills in response to changing professional requirements.

Program Distribution Requirements for the Business Major

Mathematics and Science

Mathematics (4/3 units)

Mathematics must include 2/3 units of calculus and 2/3 units of statistics.

Item #	Title	Units
MA 1021	Calculus I	1/3
MA 1022	Calculus II	1/3
MA 2611	Applied Statistics I	1/3
MA 2612	Applied Statistics II	1/3

Computer Science (1/3 unit)

A minimum of 1/3 unit of Computer Science focused on programming.
CS 1004, CS 1101, or CS 1102 is recommended. (CS 2022 and CS 3043 are not accepted.)

Item #	Title	Units
CS 1004	Introduction to Programming for Non-Majors	1/3
CS 1101	Introduction to Program Design	1/3
CS 1102	Accelerated Introduction to Program Design	1/3

Basic Science (2/3 unit)

Courses with prefix: BB, CH, GE, PH

Business Foundation

Business Foundation (11/3 units)

Item #	Title	Units
	ECON 1110 or ECON 1120 or ECON 2910/ETR 2910	1/3
	ID 2050 or one from DEV, ECON, ENV, GOV, PSY, SD, SOC, SS, STS	1/3
OBC 1010	Leadership Practice	1/3
BUS 1020	Global Environment of Business Decisions	1/3
BUS 2020	The Legal Environment of Business Decisions	1/3
ACC 2060	Financial Statements for Decision Making	1/3
BUS 2080	Data Analysis for Decision Making	1/3
FIN 2070	Risk Analysis for Decision Making	1/3
MIS 3010	Creating Value Through Innovation	1/3
MKT 4030	Achieving Strategic Effectiveness	1/3
OIE 3020	Achieving Effective Operations	1/3

ECON 1110 or ECON 1120 or ECON/ETR 2910 and ID 2050 or one from DEV, ECON, ENV, GOV, PSY, SD, SOC, SS, STS fulfill the WPI Social Science requirement.

Business Major with Business Analytics Concentration (6/3 unit)

Select one programing course from CS 2119 (take CS 1004 first) or CS 2102/2103 (take 1101/1102 first)

Item #	Title	Units
CS 2102	Object-Oriented Design Concepts	1/3
CS 2103	Accelerated Object-Oriented Design Concepts	1/3
CS 2119	Application Building with Object-Oriented Concepts	1/3

Select one from: MIS 3720 or CS 3431.

Item #	Title	Units
CS 3431	Database Systems I	1/3
MIS 3720	Business Data Management	1/3

Select one Math elective from: MA 2071, MA 2621, MA 3231, MA 3627.

Item #	Title	Units
MA 2071	Matrices and Linear Algebra I	1/3
MA 2621	Probability for Applications	1/3
MA 3231	Linear Programming	1/3
MA 3627	Introduction to the Design and Analysis of Experiments	1/3

Select three business domain, analytics electives, at least two at the 4000 level. Recommended courses include: MIS 4084, MIS 4720, MIS 4741; MKT 3650; OIE 2600, OIE 3420, OIE 3460, OIE 4430.

Item #	Title	Units
MIS 4084	Business Intelligence	1/3
MIS 4720	Systems Analysis and Design	1/3
MIS 4741	User Experience and Design	1/3
MKT 3650	Consumer Behavior	1/3
OIE 2600	Scripting for Process and Productivity Improvement	1/3
OIE 3420	Quality Planning, Design and Control	1/3
OIE 3460	Simulation Modeling and Analysis	1/3
OIE 4430	Advanced Prescriptive Analytics: From Data to Impact	1/3

Breadth Electives (3/3 unit)

Breadth Electives must include at least 1/3 unit from 3,000- or 4000-level courses with any of the following prefixes: ACC, BUS, ETR, FIN, MIS, MKT, OBC, OIE. The remaining 2/3 units specified in the requirement may be satisfied with courses from Mathematics, Basic Science, Computer Science, Data Science, Social Science (except ID/SS 2050), or courses with any of the following prefixes: ACC, BUS, ETR, FIN, MIS, MKT, OBC, or OIE.

Major Qualifying Project (3/3 Units)

The MQP must have a focus in the concentration area with an MQP advisor from the Business School.

Free Electives (5/3 units)

Program Chart and/or Course Flow Chart

BUSINESS
OVERVIEW OF DEGREE REQUIREMENTS

UNIVERSITY REQUIREMENTS
HUMANITIES AND ARTS (6/3 Units): 6 courses including Inquiry Seminar/Practicum
SOCIAL SCIENCE (2/3 Units): ECON 1110 or 1120 or 2910* One from DEV, ECON, ENV, GOV, PSY, SD, SOC, SS, STS or ID 2050*
PHYSICAL EDUCATION (1/3 Units)
INTERACTIVE QUALIFYING PROJECT (3/3 Unit)-3rd Year

MATHEMATICS AND SCIENCE REQUIREMENTS
BASIC SCIENCE (2/3 Units) BB, CH, GE, PH
MATHEMATICS (4/3 Units) Calculus - MA 1021; MA 1022; Statistics - MA 2611; MA 2612
COMPUTER SCIENCE (1/3 Units): CS 1004 (recommended) or CS 1101 or CS 1102

CORE BUSINESS CURRICULUM	
BUSINESS FOUNDATIONS (5/3 Units)	**BUSINESS STRATEGY AND ANALYSIS (6/3 Units)**
1. ECON 1110 Introductory Microeconomics ***or*** 1120 Introductory Macroeconomics ***or*** 2910 Economics and Entrepreneurship* 2. One from DEV, ECON, ENV, GOV, PSY, SD, SOC, SS, STS or ID 2050* 3. BUS 1020 Global Environment of Decision Making 4. BUS 2020 Legal Environment of Business Decisions 5. OBC 1010 Leadership Practice	6. ACC 2060 Financial Statements for Decision Making 7. BUS 2080 Data Analysis for Decision Making 8. FIN 2070 Risk Analysis for Decision Making 9. MIS 3010 Creating Value Through Innovation 10. MKT 4030 Achieving Strategic Effectiveness 11. OIE 3020 Achieving Effective Operations

BUSINESS CONCENTRATION OPTIONS (6/3 Units)
• Business Analytics • Financial Technology (FinTech) • Innovation for Social Change • General Business

MAJOR QUALIFYING PROJECT (3/3 Units)
The MQP must have a focus in the concentration area with an MQP advisor from the Business School.

BREADTH ELECTIVES (3/3 Units)
Breadth Electives must include at least 1/3 unit from 3,000- or 4000-level courses with any of the following prefixes: ACC, BUS, ETR, FIN, MIS, MKT, OBC, OIE. The remaining 2/3 units specified in the requirement may be satisfied with courses from Mathematics, Basic Science, Computer Science, Data Science, Social Science (except ID/SS 2050), or courses with any of the following prefixes: ACC, BUS, ETR, FIN, MIS, MKT, OBC, or OIE.

FREE ELECTIVES (5/3 Units)

*Counts toward (2/3 Units) Social Science requirement.

SUMMARY TABLE
BUSINESS CONCENTRATION COURSES 2023-24 (6/3 Units)

Business Analytics	FinTech
1. Select one programming course: CS 2119, CS 2102 or CS 2103 2. Select one: MIS 3720 or CS 3431 3. Select one Math elective: MA 2071, MA 2621, MA 3231, MA 3627 4. Select three business-domain, analytics electives, at least two at the 4000 level: MIS 4084, MIS 4720, MIS 4741, MKT 3650, OIE 2600, OIE 3420, OIE 3460, OIE 4430	1. Required: FIN 3300 2. Select four: CS 2119 or CS 2102 or CS 2103, MIS 3720, MIS 3787, MIS 4720, MIS 4741 3. One 2000-level or higher course from: CS (excluding CS 2022, CS 3043), ECON, FIN, MIS, OIE, and actuarial math courses (MA 2211, MA 2212, MA 2621)
Innovation for Social Change	**General Business**
1. Required: ETR 2900 2. Select three: ETR 3633, ETR 3915, ETR 4930, OBC 4367 3. Select two: EN 2251, ENV 2201, ENV 2310, ENV 2600, GOV 2311, GOV 2312, GOV 2319, HI 2341, HI 2403, INTL 2100, PSY 1402, PY/RE 2731, SD 1510, SOC 1202	Complete six courses from no more than three areas: 1. Accounting & Finance: FIN 3300 2. Economics: ECON 2110, ECON 2117, ECON 2120, ECON 2125, ECON 2130, ECON 2135, ECON 2145, ECON 2155, ECON/ETR 2910 3. Entrepreneurship: ETR 2900, ETR/ECON 2910, ETR 3633, ETR 3915, ETR 4930 4. Law: GOV 1310, GOV 2310, GOV 2311, GOV 2312, GOV 2313, GOV 2314 5. Marketing: MKT 3640, MKT 3650 6. Organizational Behavior: BUS 4300, OBC 3354, OBC 4367 7. Psychology: PSY 1401, PSY 1402, PSY 1504, PSY 2406

Business Major with Concentration in Financial Technology

Degree Type

Concentration

Educational Objectives

Objectives of the Business Major are:

- To prepare students for management roles in technology-based organizations.
- Through a flexible curriculum, to provide a solid, broad base of business knowledge and the written communication, oral presentation, decision-making, and leadership skills necessary to succeed in a technology-based environment.
- To develop student abilities necessary for continued career growth including:
    - the ability to integrate theory and practice;
    - the ability to integrate technology and change into existing organizations;
    - the ability to think critically and analytically, to define and solve business problems, work in teams, and think globally; and
    - the ability to learn new skills in response to changing professional requirements.

Program Distribution Requirements for the Business Major

Mathematics and Science

Mathematics (4/3 units)

Mathematics must include 2/3 units of calculus and 2/3 units of statistics.

Item #	Title	Units
MA 1021	Calculus I	1/3
MA 1022	Calculus II	1/3
MA 2611	Applied Statistics I	1/3
MA 2612	Applied Statistics II	1/3

Computer Science (1/3 unit)

A minimum of 1/3 unit of Computer Science focused on programming.
CS 1004, CS 1101, or CS 1102 recommended. (CS 2022 and CS 3043 are not accepted.)

Item #	Title	Units
CS 1004	Introduction to Programming for Non-Majors	1/3
CS 1101	Introduction to Program Design	1/3
CS 1102	Accelerated Introduction to Program Design	1/3

Basic Science (2/3 unit)

Biology, Chemistry, Geology, Physics

Business Curriculum

Business Foundation (11/3 units)

Item #	Title	Units
	ECON 1110 or ECON 1120 or ECON 2910/ETR 2910	1/3
	ID 2050 or one from DEV, ECON, ENV, GOV, PSY, SD, SOC, SS, STS	1/3
OBC 1010	Leadership Practice	1/3
BUS 1020	Global Environment of Business Decisions	1/3
BUS 2020	The Legal Environment of Business Decisions	1/3
ACC 2060	Financial Statements for Decision Making	1/3
BUS 2080	Data Analysis for Decision Making	1/3
FIN 2070	Risk Analysis for Decision Making	1/3
MIS 3010	Creating Value Through Innovation	1/3
MKT 4030	Achieving Strategic Effectiveness	1/3
OIE 3020	Achieving Effective Operations	1/3

ECON 1110 or ECON 1120 or ECON/ETR 2910 and ID 2050 or one from DEV, ECON, ENV, GOV, PSY, SD, SOC, SS, STS fulfill the WPI Social Science requirement.

Financial Technology Concentration (6/3 unit)

Required course: FIN 3300

Item #	Title	Units
FIN 3300	Finance & Technology (FinTech)	1/3

Select four courses from the following list:

(CS 2119 or CIS 2102 or CIS 2103) MIS 3720, MIS 3787, MIS 4720, MIS 4741

Item #	Title	Units
	CS 2119 or CS 2102 or CS 2103	1/3
MIS 3720	Business Data Management	1/3
MIS 3787	Business Applications of Machine Learning	1/3
MIS 4720	Systems Analysis and Design	1/3
MIS 4741	User Experience and Design	1/3

One 2000-level or higher course from CS (excluding CS 2022, CS 3043), ECON, FIN, MIS, OIE, and Actuarial Math courses (MA 2211, MA 2212, MA 2621)

Breadth Electives (3/3 unit)

Breadth Electives must include at least 1/3 unit from among the 3000- and 4000-level courses in the Business department. The remaining 2/3 units specified in the requirement may be satisfied with courses from Mathematics, Basic Science, Computer Science, Data Science, Social Science (except ID/SS 2050), or courses with any of the following prefixes: ACC, BUS, ETR, FIN, MIS, MKT, OBC, or OIE.

Major Qualifying Project (3/3 Units)

The MQP must have a focus in the concentration area with an MQP advisor from the Business School.

Free Electives (5/3 units)

Program Chart and/or Course Flow Chart

BUSINESS
OVERVIEW OF DEGREE REQUIREMENTS

UNIVERSITY REQUIREMENTS
HUMANITIES AND ARTS (6/3 Units): 6 courses including Inquiry Seminar/Practicum
SOCIAL SCIENCE (2/3 Units): ECON 1110 or 1120 or 2910* One from DEV, ECON, ENV, GOV, PSY, SD, SOC, SS, STS or ID 2050*
PHYSICAL EDUCATION (1/3 Units)
INTERACTIVE QUALIFYING PROJECT (3/3 Unit)-3rd Year

MATHEMATICS AND SCIENCE REQUIREMENTS
BASIC SCIENCE (2/3 Units) BB, CH, GE, PH
MATHEMATICS (4/3 Units) Calculus - MA 1021; MA 1022; Statistics - MA 2611; MA 2612
COMPUTER SCIENCE (1/3 Units): CS 1004 (recommended) or CS 1101 or CS 1102

CORE BUSINESS CURRICULUM	
BUSINESS FOUNDATIONS (5/3 Units)	**BUSINESS STRATEGY AND ANALYSIS (6/3 Units)**
1. ECON 1110 Introductory Microeconomics ***or*** 1120 Introductory Macroeconomics ***or*** 2910 Economics and Entrepreneurship* 2. One from DEV, ECON, ENV, GOV, PSY, SD, SOC, SS, STS or ID 2050* 3. BUS 1020 Global Environment of Decision Making 4. BUS 2020 Legal Environment of Business Decisions 5. OBC 1010 Leadership Practice	6. ACC 2060 Financial Statements for Decision Making 7. BUS 2080 Data Analysis for Decision Making 8. FIN 2070 Risk Analysis for Decision Making 9. MIS 3010 Creating Value Through Innovation 10. MKT 4030 Achieving Strategic Effectiveness 11. OIE 3020 Achieving Effective Operations

BUSINESS CONCENTRATION OPTIONS (6/3 Units)
• Business Analytics • Financial Technology (FinTech) • Innovation for Social Change • General Business

MAJOR QUALIFYING PROJECT (3/3 Units)
The MQP must have a focus in the concentration area with an MQP advisor from the Business School.

BREADTH ELECTIVES (3/3 Units)
Breadth Electives must include at least 1/3 unit from 3,000- or 4000-level courses with any of the following prefixes: ACC, BUS, ETR, FIN, MIS, MKT, OBC, OIE. The remaining 2/3 units specified in the requirement may be satisfied with courses from Mathematics, Basic Science, Computer Science, Data Science, Social Science (except ID/SS 2050), or courses with any of the following prefixes: ACC, BUS, ETR, FIN, MIS, MKT, OBC, or OIE.

FREE ELECTIVES (5/3 Units)

*Counts toward (2/3 Units) Social Science requirement.

SUMMARY TABLE
BUSINESS CONCENTRATION COURSES 2023-24 (6/3 Units)

Business Analytics	FinTech
1. Select one programming course: CS 2119, CS 2102 or CS 2103 2. Select one: MIS 3720 or CS 3431 3. Select one Math elective: MA 2071, MA 2621, MA 3231, MA 3627 4. Select three business-domain, analytics electives, at least two at the 4000 level: MIS 4084, MIS 4720, MIS 4741, MKT 3650, OIE 2600, OIE 3420, OIE 3460, OIE 4430	1. Required: FIN 3300 2. Select four: CS 2119 or CS 2102 or CS 2103, MIS 3720, MIS 3787, MIS 4720, MIS 4741 3. One 2000-level or higher course from: CS (excluding CS 2022, CS 3043), ECON, FIN, MIS, OIE, and actuarial math courses (MA 2211, MA 2212, MA 2621)
Innovation for Social Change	**General Business**
1. Required: ETR 2900 2. Select three: ETR 3633, ETR 3915, ETR 4930, OBC 4367 3. Select two: EN 2251, ENV 2201, ENV 2310, ENV 2600, GOV 2311, GOV 2312, GOV 2319, HI 2341, HI 2403, INTL 2100, PSY 1402, PY/RE 2731, SD 1510, SOC 1202	Complete six courses from no more than three areas: 1. Accounting & Finance: FIN 3300 2. Economics: ECON 2110, ECON 2117, ECON 2120, ECON 2125, ECON 2130, ECON 2135, ECON 2145, ECON 2155, ECON/ETR 2910 3. Entrepreneurship: ETR 2900, ETR/ECON 2910, ETR 3633, ETR 3915, ETR 4930 4. Law: GOV 1310, GOV 2310, GOV 2311, GOV 2312, GOV 2313, GOV 2314 5. Marketing: MKT 3640, MKT 3650 6. Organizational Behavior: BUS 4300, OBC 3354, OBC 4367 7. Psychology: PSY 1401, PSY 1402, PSY 1504, PSY 2406

Business Major with Concentration in General Business

Degree Type
Concentration

Educational Objectives

Objectives of the Business Major are:

- To prepare students for management roles in technology-based organizations.
- Through a flexible curriculum, to provide a solid, broad base of business knowledge and the written communication, oral presentation, decision-making, and leadership skills necessary to succeed in a technology-based environment.
- To develop student abilities necessary for continued career growth including:
    - the ability to integrate theory and practice;
    - the ability to integrate technology and change into existing organizations;
    - the ability to think critically and analytically, to define and solve business problems, work in teams, and think globally; and
    - the ability to learn new skills in response to changing professional requirements.

Program Distribution Requirements for the Business Major

Mathematics and Science

Mathematics (4/3 units)

Mathematics must include 2/3 units of calculus and 2/3 units of statistics.

Item #	Title	Units
MA 1021	Calculus I	1/3
MA 1022	Calculus II	1/3
MA 2611	Applied Statistics I	1/3
MA 2612	Applied Statistics II	1/3

Computer Science (1/3 unit)

A minimum of 1/3 unit of Computer Science focused on programming.
CS 1004, CS 1101, or CS 1102 is recommended. (CS 2022 and CS 3043 are not accepted.)

Item #	Title	Units
CS 1004	Introduction to Programming for Non-Majors	1/3
CS 1101	Introduction to Program Design	1/3
CS 1102	Accelerated Introduction to Program Design	1/3

Basic Science (2/3 unit)

Biology, Chemistry, Geology, Physics

Business Curriculum

Business Foundation (11/3 units)

Item #	Title	Units
	ECON 1110 or ECON 1120 or ECON 2910/ETR 2910	1/3
	ID 2050 or one from DEV, ECON, ENV, GOV, PSY, SD, SOC, SS, STS	1/3
OBC 1010	Leadership Practice	1/3
BUS 1020	Global Environment of Business Decisions	1/3
BUS 2020	The Legal Environment of Business Decisions	1/3
ACC 2060	Financial Statements for Decision Making	1/3
BUS 2080	Data Analysis for Decision Making	1/3
FIN 2070	Risk Analysis for Decision Making	1/3
MIS 3010	Creating Value Through Innovation	1/3
MKT 4030	Achieving Strategic Effectiveness	1/3
OIE 3020	Achieving Effective Operations	1/3

ECON 1110 or 1120 or 2910 and ID 2050 or one from DEV, ECON, ENV, GOV, PSY, SD, SOC, SS, STS fulfill the WPI Social Science requirement.

General Business Concentration (6/3 unit)

Complete six courses from no more than three areas.

Accounting & Finance

Item #	Title	Units
FIN 3300	Finance & Technology (FinTech)	1/3

Economics

Item #	Title	Units
ECON 2110	Intermediate Microeconomics	1/3
ECON 2120	Intermediate Macroeconomics	1/3
ECON 2130	Econometric Modeling	1/3
ECON 2135	Information Economics and Policy	1/3
ECON 2145	Behavioral Economics	1/3
ECON 2155	Experimental Economics	1/3
ECON 3117	Environmental Economics	1/3
ECON 3125	Development Economics	1/3

Entrepreneurship

Item #	Title	Units
ECON 2910/ETR 2910	Economics and Entrepreneurship	1/3
ETR 2900	Social Entrepreneurship	1/3
ETR 3633	Entrepreneurial Selling	1/3
ETR 3915	Entrepreneurial Business Models	1/3
ETR 4930	Growing and Managing New Ventures	1/3

Law

Item #	Title	Units
GOV 1310	Law, Courts, and Politics	1/3
GOV 2310	Constitutional Law: Foundations of Government	1/3
GOV 2311	Environmental Policy and Law	1/3
GOV 2313	Intellectual Property Law	1/3
GOV 2314/ID 2314	Cyberlaw and Policy	1/3
GOV 3312	International Environmental Policy	1/3

Marketing

Item #	Title	Units
MKT 3640	Management of Process and Product Innovation	1/3
MKT 3650	Consumer Behavior	1/3

Organizational Behavior

Item #	Title	Units
BUS 4300	Senior Seminar	1/3
OBC 3354	Organizational Behavior and Change	1/3
OBC 4367	Leadership, Ethics, and Social Responsibility	1/3

Psychology

Item #	Title	Units
PSY 1401	Cognitive Psychology	1/3
PSY 1402	Social Psychology	1/3
PSY 1504	Strategies for Improving Cognitive Skills	1/3
PSY 2406	Cross-Cultural Psychology: Human Behavior in Global Perspective	1/3

Breadth Electives (3/3 unit)

Breadth Electives must include at least 1/3 unit from among the 3000- and 4000-level courses in the Business department. The remaining 2/3 units specified in the requirement may be satisfied with courses from Mathematics, Basic Science, Computer Science, Data Science, Social Science (except ID/SS 2050), or courses with any of the following prefixes: ACC, BUS, ETR, FIN, MIS, MKT, OBC, or OIE.

Major Qualifying Project (3/3 Units)

The MQP must have a focus in the concentration area with an MQP advisor from the Business School.

Free Electives (5/3 Units)

Program Chart and/or Course Flow Chart

BUSINESS
OVERVIEW OF DEGREE REQUIREMENTS

UNIVERSITY REQUIREMENTS

HUMANITIES AND ARTS (6/3 Units): 6 courses including Inquiry Seminar/Practicum

SOCIAL SCIENCE (2/3 Units): ECON 1110 or 1120 or 2910*
One from DEV, ECON, ENV, GOV, PSY, SD, SOC, SS, STS or ID 2050*

PHYSICAL EDUCATION (1/3 Units)

INTERACTIVE QUALIFYING PROJECT (3/3 Unit)-3rd Year

MATHEMATICS AND SCIENCE REQUIREMENTS

BASIC SCIENCE (2/3 Units)
BB, CH, GE, PH

MATHEMATICS (4/3 Units)
Calculus - MA 1021; MA 1022; Statistics - MA 2611; MA 2612

COMPUTER SCIENCE (1/3 Units):
CS 1004 (recommended) or CS 1101 or CS 1102

CORE BUSINESS CURRICULUM

BUSINESS FOUNDATIONS (5/3 Units)

1. ECON 1110 Introductory Microeconomics ***or*** 1120 Introductory Macroeconomics ***or*** 2910 Economics and Entrepreneurship*
2. One from DEV, ECON, ENV, GOV, PSY, SD, SOC, SS, STS or ID 2050*
3. BUS 1020 Global Environment of Decision Making
4. BUS 2020 Legal Environment of Business Decisions
5. OBC 1010 Leadership Practice

BUSINESS STRATEGY AND ANALYSIS (6/3 Units)

6. ACC 2060 Financial Statements for Decision Making
7. BUS 2080 Data Analysis for Decision Making
8. FIN 2070 Risk Analysis for Decision Making
9. MIS 3010 Creating Value Through Innovation
10. MKT 4030 Achieving Strategic Effectiveness
11. OIE 3020 Achieving Effective Operations

BUSINESS CONCENTRATION OPTIONS (6/3 Units)

- Business Analytics
- Financial Technology (FinTech)
- Innovation for Social Change
- General Business

MAJOR QUALIFYING PROJECT (3/3 Units)
The MQP must have a focus in the concentration area with an MQP advisor from the Business School.

BREADTH ELECTIVES (3/3 Units)

Breadth Electives must include at least 1/3 unit from 3,000- or 4000-level courses with any of the following prefixes: ACC, BUS, ETR, FIN, MIS, MKT, OBC, OIE. The remaining 2/3 units specified in the requirement may be satisfied with courses from Mathematics, Basic Science, Computer Science, Data Science, Social Science (except ID/SS 2050), or courses with any of the following prefixes: ACC, BUS, ETR, FIN, MIS, MKT, OBC, or OIE.

FREE ELECTIVES (5/3 Units)

*Counts toward (2/3 Units) Social Science requirement.

SUMMARY TABLE
BUSINESS CONCENTRATION COURSES 2023-24 (6/3 Units)

Business Analytics	FinTech
1. Select one programming course: CS 2119, CS 2102 or CS 2103 2. Select one: MIS 3720 or CS 3431 3. Select one Math elective: MA 2071, MA 2621, MA 3231, MA 3627 4. Select three business-domain, analytics electives, at least two at the 4000 level: MIS 4084, MIS 4720, MIS 4741, MKT 3650, OIE 2600, OIE 3420, OIE 3460, OIE 4430	1. Required: FIN 3300 2. Select four: CS 2119 or CS 2102 or CS 2103, MIS 3720, MIS 3787, MIS 4720, MIS 4741 3. One 2000-level or higher course from: CS (excluding CS 2022, CS 3043), ECON, FIN, MIS, OIE, and actuarial math courses (MA 2211, MA 2212, MA 2621)
Innovation for Social Change	**General Business**
1. Required: ETR 2900 2. Select three: ETR 3633, ETR 3915, ETR 4930, OBC 4367 3. Select two: EN 2251, ENV 2201, ENV 2310, ENV 2600, GOV 2311, GOV 2312, GOV 2319, HI 2341, HI 2403, INTL 2100, PSY 1402, PY/RE 2731, SD 1510, SOC 1202	Complete six courses from no more than three areas: 1. Accounting & Finance: FIN 3300 2. Economics: ECON 2110, ECON 2117, ECON 2120, ECON 2125, ECON 2130, ECON 2135, ECON 2145, ECON 2155, ECON/ETR 2910 3. Entrepreneurship: ETR 2900, ETR/ECON 2910, ETR 3633, ETR 3915, ETR 4930 4. Law: GOV 1310, GOV 2310, GOV 2311, GOV 2312, GOV 2313, GOV 2314 5. Marketing: MKT 3640, MKT 3650 6. Organizational Behavior: BUS 4300, OBC 3354, OBC 4367 7. Psychology: PSY 1401, PSY 1402, PSY 1504, PSY 2406

Business Major with Concentration in Innovation for Social Change

Degree Type
Concentration

Educational Objectives

Objectives of the Business Major are:

- To prepare students for management roles in technology-based organizations.
- Through a flexible curriculum, to provide a solid, broad base of business knowledge and the written communication, oral presentation, decision-making, and leadership skills necessary to succeed in a technology-based environment.
- To develop student abilities necessary for continued career growth including:
    - the ability to integrate theory and practice;
    - the ability to integrate technology and change into existing organizations;
    - the ability to think critically and analytically, to define and solve business problems, work in teams, and think globally; and
    - the ability to learn new skills in response to changing professional requirements.

Program DIstribution Requirements for the Business Major

Mathematics and Science

Mathematics (4/3 units)

Mathematics must include 2/3 units of calculus and 2/3 units of statistics.

Item #	Title	Units
MA 1021	Calculus I	1/3
MA 1022	Calculus II	1/3
MA 2611	Applied Statistics I	1/3
MA 2612	Applied Statistics II	1/3

Computer Science (1/3 unit)

A minimum of 1/3 unit of Computer Science focused on programming.
CS 1004, CS 1101, or CS 1102 is recommended. (CS 2022 and CS 3043 are not accepted.)

Item #	Title	Units
CS 1004	Introduction to Programming for Non-Majors	1/3
CS 1101	Introduction to Program Design	1/3
CS 1102	Accelerated Introduction to Program Design	1/3

Basic Science (2/3 unit)

Biology, Chemistry, Geology, Physics

Business Core Curriculum

Business Foundation (11/3 units)

Item #	Title	Units
	ECON 1110 or ECON 1120 or ECON 2910/ETR 2910	1/3
	ID 2050 or one from DEV, ECON, ENV, GOV, PSY, SD, SOC, SS, STS	1/3
OBC 1010	Leadership Practice	1/3
BUS 1020	Global Environment of Business Decisions	1/3
BUS 2020	The Legal Environment of Business Decisions	1/3
ACC 2060	Financial Statements for Decision Making	1/3
BUS 2080	Data Analysis for Decision Making	1/3
FIN 2070	Risk Analysis for Decision Making	1/3
MIS 3010	Creating Value Through Innovation	1/3
MKT 4030	Achieving Strategic Effectiveness	1/3
OIE 3020	Achieving Effective Operations	1/3

ECON 1110 or ECON 1120 or ECON/ETR 2900 and ID 2050 or one from DEV, ECON, ENV, GOV, PSY, SD, SOC, SS, STS fulfill the WPI Social Science requirement.

Innovation for Social Change (6/3 unit)

Required course: ETR 2900

Item #	Title	Units
ETR 2900	Social Entrepreneurship	1/3

Select three courses from the following list: ETR 3633, ETR 3915, ETR 4930, OBC 4367

Item #	Title	Units
ETR 3633	Entrepreneurial Selling	1/3
ETR 3915	Entrepreneurial Business Models	1/3
ETR 4930	Growing and Managing New Ventures	1/3
OBC 4367	Leadership, Ethics, and Social Responsibility	1/3

Select two: EN 2251, ENV 2201, ENV 2310, ENV 2600, GOV 2311, GOV 2312, GOV 2319, HI 2341, HI 2403, INTL 2100, PSY 1402, PY/RE 2731, SD 1510, SOC 1202

Item #	Title	Units
EN 2251	Moral Issues in the Modern Novel	1/3
ENV 2201	Planning for Sustainable Communities	1/3
ENV 2310	Environmental Governance and Innovation	1/3
ENV 2600	Environmental Problems in the Developing World	1/3
GOV 2311	Environmental Policy and Law	1/3
GOV 3312	International Environmental Policy	1/3
HI 2341	Contemporaryworld Issues in Historical Perspective	1/3
HI 2403	Global Environmental History	1/3
INTL 2100	Approaches to Global Studies	1/3
PSY 1402	Social Psychology	1/3
PY 2731/RE 2731	Ethics	1/3
SD 1510	Introduction to System Dynamics Modeling	1/3
SOC 1202	Introduction to Sociology and Cultural Diversity	1/3

Breadth Electives (3/3 unit)

Breadth Electives must include at least 1/3 unit from 3,000- or 4000-level courses with any of the following prefixes: ACC, BUS, ETR, FIN, MIS, MKT, OBC, OIE. The remaining 2/3 units specified in the requirement may be satisfied with courses from Mathematics, Basic Science, Computer Science, Data Science, Social Science (except ID/SS 2050), or courses with any of the following prefixes: ACC, BUS, ETR, FIN, MIS, MKT, OBC, or OIE.

Major Qualifying Project (3/3 Units)

The MQP must have a focus in the concentration area with an MQP advisor from the Business School.

Free Electives (5/3 units)

Program Chart and/or Course Flow Chart

BUSINESS
OVERVIEW OF DEGREE REQUIREMENTS

UNIVERSITY REQUIREMENTS
HUMANITIES AND ARTS (6/3 Units): 6 courses including Inquiry Seminar/Practicum
SOCIAL SCIENCE (2/3 Units): ECON 1110 or 1120 or 2910* One from DEV, ECON, ENV, GOV, PSY, SD, SOC, SS, STS or ID 2050*
PHYSICAL EDUCATION (1/3 Units)
INTERACTIVE QUALIFYING PROJECT (3/3 Unit)-3rd Year

MATHEMATICS AND SCIENCE REQUIREMENTS
BASIC SCIENCE (2/3 Units) BB, CH, GE, PH
MATHEMATICS (4/3 Units) Calculus - MA 1021; MA 1022; Statistics - MA 2611; MA 2612
COMPUTER SCIENCE (1/3 Units): CS 1004 (recommended) or CS 1101 or CS 1102

CORE BUSINESS CURRICULUM	
BUSINESS FOUNDATIONS (5/3 Units)	**BUSINESS STRATEGY AND ANALYSIS (6/3 Units)**
1. ECON 1110 Introductory Microeconomics ***or*** 1120 Introductory Macroeconomics ***or*** 2910 Economics and Entrepreneurship* 2. One from DEV, ECON, ENV, GOV, PSY, SD, SOC, SS, STS or ID 2050* 3. BUS 1020 Global Environment of Decision Making 4. BUS 2020 Legal Environment of Business Decisions 5. OBC 1010 Leadership Practice	6. ACC 2060 Financial Statements for Decision Making 7. BUS 2080 Data Analysis for Decision Making 8. FIN 2070 Risk Analysis for Decision Making 9. MIS 3010 Creating Value Through Innovation 10. MKT 4030 Achieving Strategic Effectiveness 11. OIE 3020 Achieving Effective Operations

BUSINESS CONCENTRATION OPTIONS (6/3 Units)
• Business Analytics • Financial Technology (FinTech) • Innovation for Social Change • General Business

MAJOR QUALIFYING PROJECT (3/3 Units)
The MQP must have a focus in the concentration area with an MQP advisor from the Business School.

BREADTH ELECTIVES (3/3 Units)
Breadth Electives must include at least 1/3 unit from 3,000- or 4000-level courses with any of the following prefixes: ACC, BUS, ETR, FIN, MIS, MKT, OBC, OIE. The remaining 2/3 units specified in the requirement may be satisfied with courses from Mathematics, Basic Science, Computer Science, Data Science, Social Science (except ID/SS 2050), or courses with any of the following prefixes: ACC, BUS, ETR, FIN, MIS, MKT, OBC, or OIE.

FREE ELECTIVES (5/3 Units)

*Counts toward (2/3 Units) Social Science requirement.

SUMMARY TABLE
BUSINESS CONCENTRATION COURSES 2023-24 (6/3 Units)

Business Analytics	FinTech
1. Select one programming course: CS 2119, CS 2102 or CS 2103 2. Select one: MIS 3720 or CS 3431 3. Select one Math elective: MA 2071, MA 2621, MA 3231, MA 3627 4. Select three business-domain, analytics electives, at least two at the 4000 level: MIS 4084, MIS 4720, MIS 4741, MKT 3650, OIE 2600, OIE 3420, OIE 3460, OIE 4430	1. Required: FIN 3300 2. Select four: CS 2119 or CS 2102 or CS 2103, MIS 3720, MIS 3787, MIS 4720, MIS 4741 3. One 2000-level or higher course from: CS (excluding CS 2022, CS 3043), ECON, FIN, MIS, OIE, and actuarial math courses (MA 2211, MA 2212, MA 2621)
Innovation for Social Change	**General Business**
1. Required: ETR 2900 2. Select three: ETR 3633, ETR 3915, ETR 4930, OBC 4367 3. Select two: EN 2251, ENV 2201, ENV 2310, ENV 2600, GOV 2311, GOV 2312, GOV 2319, HI 2341, HI 2403, INTL 2100, PSY 1402, PY/RE 2731, SD 1510, SOC 1202	Complete six courses from no more than three areas: 1. Accounting & Finance: FIN 3300 2. Economics: ECON 2110, ECON 2117, ECON 2120, ECON 2125, ECON 2130, ECON 2135, ECON 2145, ECON 2155, ECON/ETR 2910 3. Entrepreneurship: ETR 2900, ETR/ECON 2910, ETR 3633, ETR 3915, ETR 4930 4. Law: GOV 1310, GOV 2310, GOV 2311, GOV 2312, GOV 2313, GOV 2314 5. Marketing: MKT 3640, MKT 3650 6. Organizational Behavior: BUS 4300, OBC 3354, OBC 4367 7. Psychology: PSY 1401, PSY 1402, PSY 1504, PSY 2406

Financial Technology Major with Concentration in Financial Analytics

Degree Type
Concentration

Educational Objectives

Educational Objectives of the Financial Technology Major are:

- Key technologies of the FinTech industry, including artificial intelligence (AI) & machine learning (ML) & natural language processing (NPL), blockchain & cryptocurrency, and smart contracts.
- Relevant programming skills.
- Recent innovations in the financial services industry, including payment, credit, capital markets, insurance, and real estate.
- The limitations and challenges of FinTech (e.g., inclusion, regulation).
- Emerging areas for entrepreneurial opportunities in the FinTech sector
- The operational and strategic goals of financial institutions and intermediaries, and how technology is reshaping not only the traditional areas of finance (e.g., alternative lending ("alt- finance")) and wealth management but also in related fields such as insurance ("Insur-tech") and real estate.
- The information and communication tools, technologies, and standards integral to consumer, merchant, and enterprise services in the payments and financial service sectors. These technologies span messaging, communication networks and gateways, core processing, mobile and online software, and application program interfaces (APIs).
- The basic legal frameworks of the U.S. banking and securities sectors, how new technologies ("FinTech") are transforming legacy banking and securities business models, and how new information technologies may be able to deliver financial services to communities historically excluded from the banking and/or securities sectors.

Program Distribution Requirements for the FinTech Major

Mathematics and Science

Mathematics (5/3 Units)

Mathematics must include 2/3 units Calculus, 2/3 units Statistics and 1/3 unit from MA 2071 Matrices and Linear Algebra I, MA 2072 Accelerated Matrices and Linear Algebra I, or MA 2073 Matrices and Linear Algebra II.

Item #	Title	Units
MA 1021	Calculus I	1/3
MA 1022	Calculus II	1/3
MA 2611	Applied Statistics I	1/3
MA 2612	Applied Statistics II	1/3
	MA 2071 or MA 2072 or MA 2073	

Computer Science (1/3 Unit)

Computer Science – CS 1004, CS 1101 or CS 1102 is recommended. (CS 2022 and CS 3034 are not accepted)

Item #	Title	Units
	CS 1004 or CS 1101 or CS 1102	

Basic Science (2/3 Unit)

Biology, Chemistry, Geology, Physics

Social Science (2/3 unit)

ECON 1110 and ECON 1120 required.

Item #	Title	Units
ECON 1110	Introductory Microeconomics	1/3
ECON 1120	Introductory Macroeconomics	1/3

FinTech Courses

Business Foundation Courses (4/3 Units)

Item #	Title	Units
BUS 2020	The Legal Environment of Business Decisions	1/3
ACC 2060	Financial Statements for Decision Making	1/3
FIN 2070	Risk Analysis for Decision Making	1/3
	OBC 1010 or OBC 3354 or OBC 4367	

FinTech Foundation Courses (3/3 Unit)

The FinTech component of the curriculum is designed to provide foundational financial courses that will give students the financial preparation needed for the technical areas of the program. The FinTech core courses also introduces the student to technologies (FIN 3300) and analytical tools (FIN 3310) that firms in the financial services industry can use to disrupt the traditional delivery of financial services.

Item #	Title	Units
FIN 3300	Finance & Technology (FinTech)	1/3
FIN 3310	Financial Markets and Digital Currencies	1/3

Technical Courses (3/3 Unit)

The Technical component equips students with a working knowledge of Artificial Intelligence (AI – MIS 3730), Machine learning (ML – MIS 3787), Blockchain technologies (MIS 2300), and an understanding of how these technologies can revolutionize finance. Banks and firms can use AI and ML in the rapidly growing FinTech industry to predict customer behavior or habits via Apps that integrate various AI and ML techniques. These courses also discuss ethical uses of these technologies and tools so that students learn to use them appropriately. These tools allow the user to gain detailed insights into their customers.

Item #	Title	Units
MIS 2300	Business Applications of Blockchain	1/3
MIS 3730	Artificial Intelligence with Business Application	1/3
	MIS 3787 or CS 4342	

Analytical Courses (3/3 Unit)

The Analytical core introduces students to popular data analysis tools for decision-making. The Analytical component equips students with the applied statistical and modeling techniques needed to analyze and make predictions and inferences from complex real-world financial data. The empirical tools developed in the Analytical core - regression, classification/clustering; sampling methods (bootstrap and cross-validation); and decision tree learning will be vital skills needed for the respective concentrations.

Item #	Title	Units
	BUS 2080 or OIE 2081	
	OIE 3460 or OIE 3510 or OIE 4430	

Financial Analytics Concentration Courses

Select two from: ETR 1100, MIS 3010, 0BC 1010 or OBC 4367

Item #	Title	Units
	ETR 1100, MIS 3010, 0BC 1010 or OBC 4367	

Select four from: CS 3431, CS 4432, CS 4445, DS 1010, DS 2010, DS 3010, DS 4433, MIS 3720, OIE 2600, OIE 3510, OIE 3460, OIE 4430

Item #	Title	Units
	Select four from: CS 3431, CS 4432, CS 4445, DS 1010, DS 2010, DS 3010, DS 4433, MIS 3720, OIE 2600, OIE 3510, OIE 3460, OIE 4430	

Major Qualifying Project (3/3 units)

MQP must have a business focus related to FinTech.

Free Electives (3/3 units)

Program Chart and/or Course Flow Chart

NEW BS FINANCIAL TECHNOLOGY (FINTECH)
OVERVIEW OF DEGREE REQUIREMENTS

UNIVERSITY REQUIREMENTS (12/3 Units)

HUMANITIES AND ARTS (6/3 Units): 6 courses including Inquiry Seminar/Practicum
SOCIAL SCIENCE (2/3 Units): Satisfied by ECON 1110, ECON 1120
PHYSICAL EDUCATION (1/3 Units)
INTERACTIVE QUALIFYING PROJECT (3/3 Unit)

MATHEMATICS AND SCIENCE REQUIREMENTS (8/3 Units)

BASIC SCIENCE (2/3 Units)
Any Course with prefix: BB, CH, GE, PH

MATHEMATICS (5/3 Units)
Calculus - MA 1021; MA 1022; Statistics - MA 2611; MA 2612;
Matrices and Linear Algebra - MA 2071 or MA 2072 or MA 2073

COMPUTER SCIENCE (1/3 Units):
CS 1004 (recommended) or CS 1101 or CS 1102

BUSINESS FOUNDATION CURRICULUM (4/3 Units)
3 courses from financial competency and 1 from organizational competency

1. BUS 2020 The Legal Environment of Business Decisions
2. ACC 2060 Financial Statements for Decision Making
3. FIN 2070 Risk Analysis for Decision Making
4. OBC 3354 Organizational Behavior and Change, or OBC 1010, or OBC 4367 Leadership, Ethics, and Social Responsibility.

FINTECH FOUNDATION (3/3 Units)

1. FIN 3300 Finance, Risk Analytics and Technology
2. FIN 3310 Financial Markets and Digital Currencies
3. FIN 3330 Financial Analytics

TECHNICAL AND ANALYTICS COURSES (6/3 Units)

Technical Courses (3/3 units)	**Analytics Courses (3/3 units)**
1. MIS 2300 Business Applications of Blockchain	1. BUS 2080 Data Analysis for Decision Making, or OIE 2081 Introduction to Prescriptive Analytics
2. MIS 3787 Business Application of Machine Learning, or CS 4342. Machine Learning	2. OIE 3510 Stochastic Models, or OIE 3460 Simulation modeling and Analysis, or OIE 4430. Advanced Prescriptive Analysis: From Data to Impact
3. MIS 3730 Artificial Intelligence with Business Application	3. MIS 4084 Business Intelligence

FINTECH CONCENTRATION (6/3 Units)
Choose any 2 from: ETR 1100; OBC 1010 or OBC 4367; BUS 3010 +
Select 4 courses from a concentration below

- Financial Technologies
- Financial Analytics
- Financial Mathematics

Note: If no concentration chosen, the student will choose the remaining 4 courses from at least two of the available concentrations. This will be indicated as General on the transcript.

MAJOR QUALIFYING PROJECT (3/3 Unit)
MQP must have a business focus related to FINTECH

FREE ELECTIVES (3/3 Unit)

[Type here]

FINTECH CONCENTRATIONS

FINTECH CONCENTRATION COURSES (6/3 Units) Note: If no concentration chosen, Students will choose any 2 of the following: ETR 1100; OBC 1010 or OBC 4367; BUS 3010; then the student will choose the remaining 4 courses from at least two of the available concentrations. This will be indicated as General on the transcript.		
Financial Technologies 1. Choose any 2 of the following: ETR 1100; OBC 1010 or OBC 4367; BUS 3010 2. Chose any 4 of the following: CS 2022/MA 2201 Discrete Mathematics CS 2119 or CS 2102 Object-Oriented Design Concepts CS 2223 Algorithms CS 3516 Computer Networks CS 4120 Analysis of Algorithms CS 4341 Intro to Artificial Intelligence CS 4404 Tools and techniques in Computer Network Security CS 4516 Advanced Computer Networks CS 4518 Mobile Computing CS 4801 Introduction to Cryptography and Communication Security	**Financial Analytics** 1. Choose any 2 of the following: ETR 1100; OBC 1010 or OBC 4367; BUS 3010 2. Chose any 4 of the following: DS 1010 Introduction to Data Science DS 2010 Modeling and Data Analysis OIE 2600 Scripting for Process and Productivity Improvement DS 3010 Computational Data Intelligence CS 3431 Database Systems I MIS 3720 Business Data Management OIE 4430 Advanced Prescriptive Analysis: From Data to Impact CS 4432 Database Systems II DS 4433 Big Data Management and Analytics CS 4445 Data Mining and Knowledge Discovery in Databases OIE 3510 Stochastic Models OIE 3460 Simulation modeling and Analysis	**Financial Mathematics** 1. Choose any 2 of the following: ETR 1100; OBC 1010 or OBC 4367; BUS 3010 2. Chose any 4 of the following: MA 2210 Mathematical Methods in Decision Making MA 2211 Theory of Interest I MA 2212 Theory of Interest II MA 2621 Probability for Applications MA 3231 Linear Programming MA 3233 Discrete Optimization MA 4235 Mathematical Optimization MA 4237 Probabilistic Methods in Operations Research MA 4635 Data Analytics and Statistical Learning MA 464X Introduction to time series analysis

Financial Technology Major with Concentration in Financial Mathematics

Degree Type

Concentration

Educational Objectives

Educational Objectives of the Financial Technology Major are:

- Key technologies of the FinTech industry, including artificial intelligence (AI) & machine learning (ML) & natural language processing (NPL), blockchain & cryptocurrency, and smart contracts.
- Relevant programming skills.
- Recent innovations in the financial services industry, including payment, credit, capital markets, insurance, and real estate.
- The limitations and challenges of FinTech (e.g., inclusion, regulation).
- Emerging areas for entrepreneurial opportunities in the FinTech sector
- The operational and strategic goals of financial institutions and intermediaries, and how technology is reshaping not only the traditional areas of finance (e.g., alternative lending ("alt- finance")) and wealth management but also in related fields such as insurance ("Insur-tech") and real estate.
- The information and communication tools, technologies, and standards integral to consumer, merchant, and enterprise services in the payments and financial service sectors. These technologies span messaging, communication networks and gateways, core processing, mobile and online software, and application program interfaces (APIs).
- The basic legal frameworks of the U.S. banking and securities sectors, how new technologies ("FinTech") are transforming legacy banking and securities business models, and how new information technologies may be able to deliver financial services to communities historically excluded from the banking and/or securities sectors.

Program Distribution Requirements for the FinTech Major

Mathematics and Science

Mathematics (5/3 units)

Mathematics must include 2/3 units Calculus, 2/3 units Statistics and 1/3 unit from MA 2071 Matrices and Linear Algebra I, MA 2072 Accelerated Matrices and Linear Algebra I, or MA 2073 Matrices and Linear Algebra II.

Item #	Title	Units
MA 1021	Calculus I	1/3
MA 1022	Calculus II	1/3
MA 2611	Applied Statistics I	1/3
MA 2612	Applied Statistics II	1/3
	MA 2071 or MA 2072 or MA 2073	

Computer Science (1/3 Unit)

Computer Science – CS 1004, CS 1101 or CS 1102 is recommended. (CS 2022 and CS 3034 are not accepted)

Item #	Title	Units
	CS 1004 or CS 1101 or CS 1102	

Basic Science (2/3 Unit)

Biology, Chemistry, Geology, Physics

Social Science (2/3 unit)

ECON 1110 and ECON 1120 required.

Item #	Title	Units
ECON 1110	Introductory Microeconomics	1/3
ECON 1120	Introductory Macroeconomics	1/3

FinTech Courses

Business Foundation Courses (4/3 Units)

Item #	Title	Units
BUS 2020	The Legal Environment of Business Decisions	1/3
ACC 2060	Financial Statements for Decision Making	1/3
FIN 2070	Risk Analysis for Decision Making	1/3
	OBC 1010 or OBC 3354 or OBC 4367	

FinTech Foundation Courses (3/3 Unit)

The FinTech component of the curriculum is designed to provide foundational financial courses that will give students the financial preparation needed for the technical areas of the program. The FinTech core courses also introduces the student to technologies (FIN 3300) and analytical tools (FIN 3310) that firms in the financial services industry can use to disrupt the traditional delivery of financial services.

Item #	Title	Units
FIN 3300	Finance & Technology (FinTech)	1/3
FIN 3310	Financial Markets and Digital Currencies	1/3

Technical Courses (3/3 Unit)

The Technical component equips students with a working knowledge of Artificial Intelligence (AI – MIS 3730), Machine learning (ML – MIS 3787), Blockchain technologies (MIS 2300), and an understanding of how these technologies can revolutionize finance. Banks and firms can use AI and ML in the rapidly growing FinTech industry to predict customer behavior or habits via Apps that integrate various AI and ML techniques. These courses also discuss ethical uses of these technologies and tools so that students learn to use them appropriately. These tools allow the user to gain detailed insights into their customers.

Item #	Title	Units
MIS 2300	Business Applications of Blockchain	1/3
MIS 3720	Business Data Management	1/3
	MIS 3787 or CS 4342	

Analytical Courses (3/3 Unit)

The Analytical core introduces students to popular data analysis tools for decision-making. The Analytical component equips students with the applied statistical and modeling techniques needed to analyze and make predictions and inferences from complex real-world financial data. The empirical tools developed in the Analytical core - regression, classification/clustering; sampling methods (bootstrap and cross-validation); and decision tree learning will be vital skills needed for the respective concentrations.

Item #	Title	Units
	BUS 2080 or OIE 2081	
	OIE 3460 or OIE 3510 or OIE 4430	

Financial Mathematics Concentration Courses

Select two from: ETR 1100, MIS 3010, 0BC 1010 or OBC 4367

Item #	Title	Units
	ETR 1100, MIS 3010, 0BC 1010 or OBC 4367	

Select four from: MA 2210, MA 2211, MA 2212, MA 2621, MA 3231, MA 3233, MA 4235, MA 4237, MA 4365, MA 464X.

Item #	Title	Units
	MA 2210, MA 2211, MA 2212, MA 2621, MA 3231, MA 3233, MA 4235, MA 4237, MA 4365, MA 464X.	

Major Qualifying Project (3/3 Units)

The MQP must have a business focus related to FinTech.

Free Electives (3/3 Units)

Program Chart and/or Course Flow Chart

NEW BS FINANCIAL TECHNOLOGY (FINTECH)
OVERVIEW OF DEGREE REQUIREMENTS

UNIVERSITY REQUIREMENTS (12/3 Units)

HUMANITIES AND ARTS (6/3 Units): 6 courses including Inquiry Seminar/Practicum
SOCIAL SCIENCE (2/3 Units): Satisfied by ECON 1110, ECON 1120
PHYSICAL EDUCATION (1/3 Units)
INTERACTIVE QUALIFYING PROJECT (3/3 Unit)

MATHEMATICS AND SCIENCE REQUIREMENTS (8/3 Units)

BASIC SCIENCE (2/3 Units)
Any Course with prefix: BB, CH, GE, PH

MATHEMATICS (5/3 Units)
Calculus - MA 1021; MA 1022; Statistics - MA 2611; MA 2612;
Matrices and Linear Algebra - MA 2071 or MA 2072 or MA 2073

COMPUTER SCIENCE (1/3 Units):
CS 1004 (recommended) or CS 1101 or CS 1102

BUSINESS FOUNDATION CURRICULUM (4/3 Units)
3 courses from financial competency and 1 from organizational competency

1. BUS 2020 The Legal Environment of Business Decisions
2. ACC 2060 Financial Statements for Decision Making
3. FIN 2070 Risk Analysis for Decision Making
4. OBC 3354 Organizational Behavior and Change, or OBC 1010, or OBC 4367 Leadership, Ethics, and Social Responsibility.

FINTECH FOUNDATION (3/3 Units)

1. FIN 3300 Finance, Risk Analytics and Technology
2. FIN 3310 Financial Markets and Digital Currencies
3. FIN 3330 Financial Analytics

TECHNICAL AND ANALYTICS COURSES (6/3 Units)

Technical Courses (3/3 units)	Analytics Courses (3/3 units)
1. MIS 2300 Business Applications of Blockchain 2. MIS 3787 Business Application of Machine Learning, or CS 4342. Machine Learning 3. MIS 3730 Artificial Intelligence with Business Application	1. BUS 2080 Data Analysis for Decision Making, or OIE 2081 Introduction to Prescriptive Analytics 2. OIE 3510 Stochastic Models, or OIE 3460 Simulation modeling and Analysis, or OIE 4430. Advanced Prescriptive Analysis: From Data to Impact 3. MIS 4084 Business Intelligence

FINTECH CONCENTRATION (6/3 Units)
Choose any 2 from: ETR 1100; OBC 1010 or OBC 4367; BUS 3010 +
Select 4 courses from a concentration below

- Financial Technologies
- Financial Analytics
- Financial Mathematics

Note: If no concentration chosen, the student will choose the remaining 4 courses from at least two of the available concentrations. This will be indicated as General on the transcript.

MAJOR QUALIFYING PROJECT (3/3 Unit)
MQP must have a business focus related to FINTECH

FREE ELECTIVES (3/3 Unit)

[Type here]

FINTECH CONCENTRATIONS

FINTECH CONCENTRATION COURSES (6/3 Units) Note: If no concentration chosen, Students will choose any 2 of the following: ETR 1100; OBC 1010 or OBC 4367; BUS 3010; then the student will choose the remaining 4 courses from at least two of the available concentrations. This will be indicated as General on the transcript.		
Financial Technologies 1. Choose any 2 of the following: ETR 1100; OBC 1010 or OBC 4367; BUS 3010 2. Chose any 4 of the following: CS 2022/MA 2201 Discrete Mathematics CS 2119 or CS 2102 Object-Oriented Design Concepts CS 2223 Algorithms CS 3516 Computer Networks CS 4120 Analysis of Algorithms CS 4341 Intro to Artificial Intelligence CS 4404 Tools and techniques in Computer Network Security CS 4516 Advanced Computer Networks CS 4518 Mobile Computing CS 4801 Introduction to Cryptography and Communication Security	**Financial Analytics** 1. Choose any 2 of the following: ETR 1100; OBC 1010 or OBC 4367; BUS 3010 2. Chose any 4 of the following: DS 1010 Introduction to Data Science DS 2010 Modeling and Data Analysis OIE 2600 Scripting for Process and Productivity Improvement DS 3010 Computational Data Intelligence CS 3431 Database Systems I MIS 3720 Business Data Management OIE 4430 Advanced Prescriptive Analysis: From Data to Impact CS 4432 Database Systems II DS 4433 Big Data Management and Analytics CS 4445 Data Mining and Knowledge Discovery in Databases OIE 3510 Stochastic Models OIE 3460 Simulation modeling and Analysis	**Financial Mathematics** 1. Choose any 2 of the following: ETR 1100; OBC 1010 or OBC 4367; BUS 3010 2. Chose any 4 of the following: MA 2210 Mathematical Methods in Decision Making MA 2211 Theory of Interest I MA 2212 Theory of Interest II MA 2621 Probability for Applications MA 3231 Linear Programming MA 3233 Discrete Optimization MA 4235 Mathematical Optimization MA 4237 Probabilistic Methods in Operations Research MA 4635 Data Analytics and Statistical Learning MA 464X Introduction to time series analysis

Financial Technology Major with Concentration in Financial Technologies

Degree Type

Concentration

Educational Objectives

Educational Objectives of the Financial Technology Major are:

- Key technologies of the FinTech industry, including artificial intelligence (AI) & machine learning (ML) & natural language processing (NPL), blockchain & cryptocurrency, and smart contracts.
- Relevant programming skills.
- Recent innovations in the financial services industry, including payment, credit, capital markets, insurance, and real estate.
- The limitations and challenges of FinTech (e.g., inclusion, regulation).
- Emerging areas for entrepreneurial opportunities in the FinTech sector
- The operational and strategic goals of financial institutions and intermediaries, and how technology is reshaping not only the traditional areas of finance (e.g., alternative lending ("alt- finance")) and wealth management but also in related fields such as insurance ("Insur-tech") and real estate.
- The information and communication tools, technologies, and standards integral to consumer, merchant, and enterprise services in the payments and financial service sectors. These technologies span messaging, communication networks and gateways, core processing, mobile and online software, and application program interfaces (APIs).
- The basic legal frameworks of the U.S. banking and securities sectors, how new technologies ("FinTech") are transforming legacy banking and securities business models, and how new information technologies may be able to deliver financial services to communities historically excluded from the banking and/or securities sectors.

Program Distribution Requirements for the FinTech Major

Mathematics and Science

Mathematics (5/3 units)

Mathematics must include 2/3 units Calculus, 2/3 units Statistics and 1/3 unit from MA 2071 Matrices and Linear Algebra I, MA 2072 Accelerated Matrices and Linear Algebra I, or MA 2073 Matrices and Linear Algebra II.

Item #	Title	Units
MA 1021	Calculus I	1/3
MA 1022	Calculus II	1/3
MA 2611	Applied Statistics I	1/3
MA 2612	Applied Statistics II	1/3
	MA 2071 or MA 2072 or MA 2073	

Computer Science (1/3 Unit)

Computer Science – CS 1004, CS 1101 or CS 1102 is recommended. (CS 2022 and CS 3034 are not accepted)

Item #	Title	Units
	CS 1004 or CS 1101 or CS 1102	

Basic Science (2/3 Unit)

Biology, Chemistry, Geology, Physics

Social Science (2/3 unit)

ECON 1110 and ECON 1120 required.

Item #	Title	Units
ECON 1110	Introductory Microeconomics	1/3
ECON 1120	Introductory Macroeconomics	1/3

FinTech Courses

Business Foundation Courses (4/3 Units)

Item #	Title	Units
BUS 2020	The Legal Environment of Business Decisions	1/3
ACC 2060	Financial Statements for Decision Making	1/3
FIN 2070	Risk Analysis for Decision Making	1/3
	OBC 1010 or OBC 3354 or OBC 4367	

FinTech Foundation Courses (3/3 Unit)

The FinTech component of the curriculum is designed to provide foundational financial courses that will give students the financial preparation needed for the technical areas of the program. The FinTech core courses also introduces the student to technologies (FIN 3300) and analytical tools (FIN 3310) that firms in the financial services industry can use to disrupt the traditional delivery of financial services.

Item #	Title	Units
FIN 3300	Finance & Technology (FinTech)	1/3
FIN 3310	Financial Markets and Digital Currencies	1/3

Technical Courses (3/3 Unit)

The Technical component equips students with a working knowledge of Artificial Intelligence (AI – MIS 3730), Machine learning (ML – MIS 3787), Blockchain technologies (MIS 2300), and an understanding of how these technologies can revolutionize finance. Banks and firms can use AI and ML in the rapidly growing FinTech industry to predict customer behavior or habits via Apps that integrate various AI and ML techniques. These courses also discuss ethical uses of these technologies and tools so that students learn to use them appropriately. These tools allow the user to gain detailed insights into their customers.

Item #	Title	Units
MIS 2300	Business Applications of Blockchain	1/3
MIS 3730	Artificial Intelligence with Business Application	1/3
	MIS 3787 or CS 4342	

Analytical Curriculum (3/3 Unit)

The Analytical core introduces students to popular data analysis tools for decision-making. The Analytical component equips students with the applied statistical and modeling techniques needed to analyze and make predictions and inferences from complex real-world financial data. The empirical tools developed in the Analytical core - regression, classification/clustering; sampling methods (bootstrap and cross-validation); and decision tree learning will be vital skills needed for the respective concentrations.

Item #	Title	Units
	BUS 2080 or OIE 2081	
MIS 4084	Business Intelligence	1/3
	OIE 3460 or OIE 3510 or OIE 4430	

Financial Technologies Concentration Courses (6/3)

Select two from: ETR 1100, MIS 3010, 0BC 1010 or OBC 4367

Item #	Title	Units
	ETR 1100, MIS 3010, 0BC 1010 or OBC 4367	

Select four from: CS 2022 or MA 2201, CS 2102 or CS 2119, CS 2223, CS 3516, CS 4120, CS 4341, CS 4404, CS 4516, CS 4518, CS 4801.

Item #	Title	Units
	CS 2022 or MA 2201, CS 2102 or CS 2119, CS 2223, CS 3516, CS 4120, CS 4341, CS 4404, CS 4516, CS 4518, CS 4801	

Major Qualifying Project (3/3 units)

MQP must have a business focus related to FinTech.

Free Electives (3/3 units)

Program Chart and/or Course Flow Chart

NEW BS FINANCIAL TECHNOLOGY (FINTECH)
OVERVIEW OF DEGREE REQUIREMENTS

UNIVERSITY REQUIREMENTS (12/3 Units)

HUMANITIES AND ARTS (6/3 Units): 6 courses including Inquiry Seminar/Practicum
SOCIAL SCIENCE (2/3 Units): Satisfied by ECON 1110, ECON 1120
PHYSICAL EDUCATION (1/3 Units)
INTERACTIVE QUALIFYING PROJECT (3/3 Unit)

MATHEMATICS AND SCIENCE REQUIREMENTS (8/3 Units)

BASIC SCIENCE (2/3 Units)
Any Course with prefix: BB, CH, GE, PH

MATHEMATICS (5/3 Units)
Calculus - MA 1021; MA 1022; Statistics - MA 2611; MA 2612;
Matrices and Linear Algebra - MA 2071 or MA 2072 or MA 2073

COMPUTER SCIENCE (1/3 Units):
CS 1004 (recommended) or CS 1101 or CS 1102

BUSINESS FOUNDATION CURRICULUM (4/3 Units)
3 courses from financial competency and 1 from organizational competency

1. BUS 2020 The Legal Environment of Business Decisions
2. ACC 2060 Financial Statements for Decision Making
3. FIN 2070 Risk Analysis for Decision Making
4. OBC 3354 Organizational Behavior and Change, or OBC 1010, or OBC 4367 Leadership, Ethics, and Social Responsibility.

FINTECH FOUNDATION (3/3 Units)

1. FIN 3300 Finance, Risk Analytics and Technology
2. FIN 3310 Financial Markets and Digital Currencies
3. FIN 3330 Financial Analytics

TECHNICAL AND ANALYTICS COURSES (6/3 Units)

Technical Courses (3/3 units)	Analytics Courses (3/3 units)
1. MIS 2300 Business Applications of Blockchain 2. MIS 3787 Business Application of Machine Learning, or CS 4342. Machine Learning 3. MIS 3730 Artificial Intelligence with Business Application	1. BUS 2080 Data Analysis for Decision Making, or OIE 2081 Introduction to Prescriptive Analytics 2. OIE 3510 Stochastic Models, or OIE 3460 Simulation modeling and Analysis, or OIE 4430. Advanced Prescriptive Analysis: From Data to Impact 3. MIS 4084 Business Intelligence

FINTECH CONCENTRATION (6/3 Units)
Choose any 2 from: ETR 1100; OBC 1010 or OBC 4367; BUS 3010 +
Select 4 courses from a concentration below

- Financial Technologies
- Financial Analytics
- Financial Mathematics

Note: If no concentration chosen, the student will choose the remaining 4 courses from at least two of the available concentrations. This will be indicated as General on the transcript.

MAJOR QUALIFYING PROJECT (3/3 Unit)
MQP must have a business focus related to FINTECH

FREE ELECTIVES (3/3 Unit)

[Type here]

FINTECH CONCENTRATIONS

FINTECH CONCENTRATION COURSES (6/3 Units) Note: If no concentration chosen, Students will choose any 2 of the following: ETR 1100; OBC 1010 or OBC 4367; BUS 3010; then the student will choose the remaining 4 courses from at least two of the available concentrations. This will be indicated as General on the transcript.		
Financial Technologies 1. Choose any 2 of the following: ETR 1100; OBC 1010 or OBC 4367; BUS 3010 2. Chose any 4 of the following: CS 2022/MA 2201 Discrete Mathematics CS 2119 or CS 2102 Object-Oriented Design Concepts CS 2223 Algorithms CS 3516 Computer Networks CS 4120 Analysis of Algorithms CS 4341 Intro to Artificial Intelligence CS 4404 Tools and techniques in Computer Network Security CS 4516 Advanced Computer Networks CS 4518 Mobile Computing CS 4801 Introduction to Cryptography and Communication Security	**Financial Analytics** 1. Choose any 2 of the following: ETR 1100; OBC 1010 or OBC 4367; BUS 3010 2. Chose any 4 of the following: DS 1010 Introduction to Data Science DS 2010 Modeling and Data Analysis OIE 2600 Scripting for Process and Productivity Improvement DS 3010 Computational Data Intelligence CS 3431 Database Systems I MIS 3720 Business Data Management OIE 4430 Advanced Prescriptive Analysis: From Data to Impact CS 4432 Database Systems II DS 4433 Big Data Management and Analytics CS 4445 Data Mining and Knowledge Discovery in Databases OIE 3510 Stochastic Models OIE 3460 Simulation modeling and Analysis	**Financial Mathematics** 1. Choose any 2 of the following: ETR 1100; OBC 1010 or OBC 4367; BUS 3010 2. Chose any 4 of the following: MA 2210 Mathematical Methods in Decision Making MA 2211 Theory of Interest I MA 2212 Theory of Interest II MA 2621 Probability for Applications MA 3231 Linear Programming MA 3233 Discrete Optimization MA 4235 Mathematical Optimization MA 4237 Probabilistic Methods in Operations Research MA 4635 Data Analytics and Statistical Learning MA 464X Introduction to time series analysis

Financial Technology Major with General Concentration

Degree Type

Concentration

Educational Objectives

Educational Objectives of the Financial Technology Major are:

- Key technologies of the FinTech industry, including artificial intelligence (AI) & machine learning (ML) & natural language processing (NPL), blockchain & cryptocurrency, and smart contracts.
- Relevant programming skills.
- Recent innovations in the financial services industry, including payment, credit, capital markets, insurance, and real estate.
- The limitations and challenges of FinTech (e.g., inclusion, regulation).
- Emerging areas for entrepreneurial opportunities in the FinTech sector
- The operational and strategic goals of financial institutions and intermediaries, and how technology is reshaping not only the traditional areas of finance (e.g., alternative lending ("alt- finance")) and wealth management but also in related fields such as insurance ("Insur-tech") and real estate.
- The information and communication tools, technologies, and standards integral to consumer, merchant, and enterprise services in the payments and financial service sectors. These technologies span messaging, communication networks and gateways, core processing, mobile and online software, and application program interfaces (APIs).
- The basic legal frameworks of the U.S. banking and securities sectors, how new technologies ("FinTech") are transforming legacy banking and securities business models, and how new information technologies may be able to deliver financial services to communities historically excluded from the banking and/or securities sectors.

Program Distribution Requirements for FinTech Major

Mathematics and Science

Mathematics (5/3 units)

Mathematics must include 2/3 units Calculus, 2/3 units Statistics and 1/3 unit from MA 2071 Matrices and Linear Algebra I, MA 2072 Accelerated Matrices and Linear Algebra I, or MA 2073 Matrices and Linear Algebra II.

Item #	Title	Units
MA 1021	Calculus I	1/3
MA 1022	Calculus II	1/3
MA 2611	Applied Statistics I	1/3
MA 2612	Applied Statistics II	1/3
	MA 2071 or MA 2072 or MA 2073	

Computer Science (1/3 Unit)

Computer Science – CS 1004, CS 1101 or CS 1102 is recommended. (CS 2022 and CS 3034 are not accepted)

Item #	Title	Units
	CS 1004 or CS 1101 or CS 1102	

Basic Science (2/3 Unit)

Biology, Chemistry, Geology, Physics

Social Science (2/3 unit)

ECON 1110 and ECON 1120 required.

Item #	Title	Units
ECON 1110	Introductory Microeconomics	1/3
ECON 1120	Introductory Macroeconomics	1/3

FinTech Courses

Business Foundation Courses (4/3 Units)

Item #	Title	Units
BUS 2020	The Legal Environment of Business Decisions	1/3
ACC 2060	Financial Statements for Decision Making	1/3
FIN 2070	Risk Analysis for Decision Making	1/3
	OBC 1010 or OBC 3354 or OBC 4367	

FinTech Foundation Courses (3/3 Unit)

The Fintech component of the curriculum is designed to provide foundational financial courses that will give students the financial preparation needed for the technical areas of the program. The Fintech core courses also introduces the student to technologies (FIN 3300) and analytical tools (FIN 3310) that firms in the financial services industry can use to disrupt the traditional delivery of financial services.

Item #	Title	Units
FIN 3300	Finance & Technology (FinTech)	1/3
FIN 3310	Financial Markets and Digital Currencies	1/3

Technical Courses (3/3 Unit)

The Technical component equips students with a working knowledge of Artificial Intelligence (AI – MIS 3730), Machine learning (ML – MIS 3787), Blockchain technologies (MIS 2300), and an understanding of how these technologies can revolutionize finance. Banks and firms can use AI and ML in the rapidly growing FinTech industry to predict customer behavior or habits via Apps that integrate various AI and ML techniques. These courses also discuss ethical uses of these technologies and tools so that students learn to use them appropriately. These tools allow the user to gain detailed insights into their customers.

Item #	Title	Units
MIS 2300	Business Applications of Blockchain	1/3
MIS 3720	Business Data Management	1/3
	MIS 3787 or CS 4342	

Analytical Courses (3/3 Unit)

The Analytical core introduces students to popular data analysis tools for decision-making. The Analytical component equips students with the applied statistical and modeling techniques needed to analyze and make predictions and inferences from complex real-world financial data. The empirical tools developed in the Analytical core - regression, classification/clustering; sampling methods (bootstrap and cross-validation); and decision tree learning will be vital skills needed for the respective concentrations.

Item #	Title	Units
	BUS 2080 or OIE 2081	
	OIE 3460 or OIE 3510 or OIE 4430	

FinTech Major General Concentration Courses

Select two from: ETR 1100, MIS 3010, 0BC 1010 or OBC 4367

Item #	Title	Units
	ETR 1100, MIS 3010, 0BC 1010 or OBC 4367	

Select four from:

Financial Analytics: CS 3431, CS 4432, CS 4445, DS 1010, DS 2010, DS 3010, DS 4433, MIS 3720, OIE 2600, OIE 3510, OIE 3460, OIE 4430

Financial Technologies: CS 2022 or MA 2201, CS 2102 or CS 2119, CS 2223, CS 3516, CS 4120, CS 4341, CS 4404, CS 4516, CS 4518, CS 4801

Financial Mathematics: MA 2210, MA 2211, MA 2212, MA 2621, MA 3231, MA 3233, MA 4235, MA 4237, MA 4365, MA 464X

Item #	Title	Units
	Select four from: CS 3431, CS 4432, CS 4445, DS 1010, DS 2010, DS 3010, DS 4433, MIS 3720, OIE 2600, OIE 3510, OIE 3460, OIE 4430	
	CS 2022 or MA 2201, CS 2102 or CS 2119, CS 2223, CS 3516, CS 4120, CS 4341, CS 4404, CS 4516, CS 4518, CS 4801	
	MA 2210, MA 2211, MA 2212, MA 2621, MA 3231, MA 3233, MA 4235, MA 4237, MA 4365, MA 464X.	

Major Qualifying Project (3/3 Units)

The MQP must have a focus in the concentration area with an MQP advisor from the Business School.

Free Electives (3/3 Units)

Program Chart and/or Course Flow Chart

NEW BS FINANCIAL TECHNOLOGY (FINTECH)
OVERVIEW OF DEGREE REQUIREMENTS

<table>
<tr><th colspan="2">UNIVERSITY REQUIREMENTS (12/3 Units)</th></tr>
<tr><td colspan="2">HUMANITIES AND ARTS (6/3 Units): 6 courses including Inquiry Seminar/Practicum
SOCIAL SCIENCE (2/3 Units): Satisfied by ECON 1110, ECON 1120
PHYSICAL EDUCATION (1/3 Units)
INTERACTIVE QUALIFYING PROJECT (3/3 Unit)</td></tr>
<tr><th colspan="2">MATHEMATICS AND SCIENCE REQUIREMENTS (8/3 Units)</th></tr>
<tr><td colspan="2">BASIC SCIENCE (2/3 Units)
Any Course with prefix: BB, CH, GE, PH

MATHEMATICS (5/3 Units)
Calculus - MA 1021; MA 1022; Statistics - MA 2611; MA 2612;
Matrices and Linear Algebra - MA 2071 or MA 2072 or MA 2073

COMPUTER SCIENCE (1/3 Units):
CS 1004 (recommended) or CS 1101 or CS 1102</td></tr>
<tr><th colspan="2">BUSINESS FOUNDATION CURRICULUM (4/3 Units)
3 courses from financial competency and 1 from organizational competency</th></tr>
<tr><td colspan="2">1. BUS 2020 The Legal Environment of Business Decisions
2. ACC 2060 Financial Statements for Decision Making
3. FIN 2070 Risk Analysis for Decision Making
4. OBC 3354 Organizational Behavior and Change, or OBC 1010, or OBC 4367 Leadership, Ethics, and Social Responsibility.</td></tr>
<tr><th colspan="2">FINTECH FOUNDATION (3/3 Units)</th></tr>
<tr><td colspan="2">1. FIN 3300 Finance, Risk Analytics and Technology
2. FIN 3310 Financial Markets and Digital Currencies
3. FIN 3330 Financial Analytics</td></tr>
<tr><th colspan="2">TECHNICAL AND ANALYTICS COURSES (6/3 Units)</th></tr>
<tr><td>Technical Courses (3/3 units)
1. MIS 2300 Business Applications of Blockchain
2. MIS 3787 Business Application of Machine Learning, or CS 4342. Machine Learning
3. MIS 3730 Artificial Intelligence with Business Application</td><td>Analytics Courses (3/3 units)
1. BUS 2080 Data Analysis for Decision Making, or OIE 2081 Introduction to Prescriptive Analytics
2. OIE 3510 Stochastic Models, or OIE 3460 Simulation modeling and Analysis, or OIE 4430. Advanced Prescriptive Analysis: From Data to Impact
3. MIS 4084 Business Intelligence</td></tr>
<tr><th colspan="2">FINTECH CONCENTRATION (6/3 Units)
Choose any 2 from: ETR 1100; OBC 1010 or OBC 4367; BUS 3010 +
Select 4 courses from a concentration below</th></tr>
<tr><td colspan="2">• Financial Technologies
• Financial Analytics
• Financial Mathematics
Note: If no concentration chosen, the student will choose the remaining 4 courses from at least two of the available concentrations. This will be indicated as General on the transcript.</td></tr>
<tr><th colspan="2">MAJOR QUALIFYING PROJECT (3/3 Unit)
MQP must have a business focus related to FINTECH</th></tr>
<tr><th colspan="2">FREE ELECTIVES (3/3 Unit)</th></tr>
</table>

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FINTECH CONCENTRATIONS

FINTECH CONCENTRATION COURSES (6/3 Units) Note: If no concentration chosen, Students will choose any 2 of the following: ETR 1100; OBC 1010 or OBC 4367; BUS 3010; then the student will choose the remaining 4 courses from at least two of the available concentrations. This will be indicated as General on the transcript.		
Financial Technologies 1. Choose any 2 of the following: ETR 1100; OBC 1010 or OBC 4367; BUS 3010 2. Chose any 4 of the following: CS 2022/MA 2201 Discrete Mathematics CS 2119 or CS 2102 Object-Oriented Design Concepts CS 2223 Algorithms CS 3516 Computer Networks CS 4120 Analysis of Algorithms CS 4341 Intro to Artificial Intelligence CS 4404 Tools and techniques in Computer Network Security CS 4516 Advanced Computer Networks CS 4518 Mobile Computing CS 4801 Introduction to Cryptography and Communication Security	**Financial Analytics** 1. Choose any 2 of the following: ETR 1100; OBC 1010 or OBC 4367; BUS 3010 2. Chose any 4 of the following: DS 1010 Introduction to Data Science DS 2010 Modeling and Data Analysis OIE 2600 Scripting for Process and Productivity Improvement DS 3010 Computational Data Intelligence CS 3431 Database Systems I MIS 3720 Business Data Management OIE 4430 Advanced Prescriptive Analysis: From Data to Impact CS 4432 Database Systems II DS 4433 Big Data Management and Analytics CS 4445 Data Mining and Knowledge Discovery in Databases OIE 3510 Stochastic Models OIE 3460 Simulation modeling and Analysis	**Financial Mathematics** 1. Choose any 2 of the following: ETR 1100; OBC 1010 or OBC 4367; BUS 3010 2. Choose any 4 of the following: MA 2210 Mathematical Methods in Decision Making MA 2211 Theory of Interest I MA 2212 Theory of Interest II MA 2621 Probability for Applications MA 3231 Linear Programming MA 3233 Discrete Optimization MA 4235 Mathematical Optimization MA 4237 Probabilistic Methods in Operations Research MA 4635 Data Analytics and Statistical Learning MA 464X Introduction to time series analysis

Management Engineering Major with Concentration in Biomedical Engineering

Degree Type

Concentration

Educational Objectives

Objectives of the Management Engineering Major are:

- To prepare students for management challenges in key areas that increasingly require proficiency in the technical aspects of business such as production and service operations.
- To provide the knowledge and skills necessary to succeed professionally, including literacy in a technical field, a broad understanding of management issues, written communication, oral presentation, decision-making, and leadership skills required to create new and improved products, processes and control systems.
- To develop student abilities necessary for continued career growth including:
  - the ability to integrate theory and practice and to apply knowledge of technical issues with the foundations of management
  - the ability to integrate technology and change into existing organizations
  - the ability to think critically and analytically, to define and solve business problems, work in teams, and think globally; and
  - the ability to learn new skills in response to changing professional requirements.

Program Distribution Requirements for the Management Engineering Major

Mathematics and Science

Mathematics (4/3 units)

Mathematics must include 2/3 units of calculus and 2/3 units of statistics.

Item #	Title	Units
MA 1021	Calculus I	1/3
MA 1022	Calculus II	1/3
MA 2611	Applied Statistics I	1/3
MA 2612	Applied Statistics II	1/3

Computer Science (1/3 unit)

A minimum of 1/3 unit of Computer Science focused on programming. CS 1004, CS 1101, or CS 1102 is recommended. (CS 2022 and CS 3043 are not accepted.)

Item #	Title	Units
CS 1004	Introduction to Programming for Non-Majors	1/3
CS 1101	Introduction to Program Design	1/3
CS 1102	Accelerated Introduction to Program Design	1/3

Basic Science (2/3 unit)

Any course with prefix: BB, CH, GE, PH

Social Sciences (2/3 unit)

ECON 1110 or ECON 1120 or ECON 2910/ETR 2910 and

ID 2050 or one from DEV, ECON, ENV, GOV, PSY, SD, SOC, SS, STS.

Item #	Title	Units
	ECON 1110 or ECON 1120 or ECON 2910/ETR 2910	1/3
	ID 2050 or one from DEV, ECON, ENV, GOV, PSY, SD, SOC, SS, STS	1/3

Management Engineering Core Curriculum

Financial Courses (3/3 unit)*

ACC 2060: Financial Statements for Decision Making; Select one course from: FIN 1250 Personal Finance, FIN 2070 Fundamentals of Finance, FIN 3300 Finance & Technology (FinTech); OIE 2850 Engineering Economics.

*Two courses at 3,000 level or above required across Financial and Managerial courses.

Item #	Title	Units
ACC 2060	Financial Statements for Decision Making	1/3
	FIN 1250 or FIN 2070 or FIN 3300	
OIE 2850	Engineering Economics	1/3

Managerial Courses (3/3 unit)*

Select one organizational behavior course (Recommended OBC 1010 Leadership Practice); Select one marketing course (Recommended MKT 4030 Achieving Strategic Effectiveness); Select one course from BUS 2020 The Legal Environment of Business Decisions, MIS 3010 Creating Value through Innovation, any course with an ETR, MKT, or OBC prefix.

*Two courses at 3,000 level or above required across Financial and Managerial courses.

Item #	Title	Units
OBC 1010	Leadership Practice	1/3
MKT 4030	Achieving Strategic Effectiveness	1/3
	BUS 2020 or MIS 3010, ETR, MKT, OBC course	1/3

Technical Courses (3/3 unit)

OIE 3020 Achieving Effective Operations; Select two courses from the following: AE, BB, BME, CE (except 3022), CH, CHE, CS (except 3043), DS, ECE, ES (except 1000), GE, OIE, MA, ME, PH, RBE (except 3100).

Item #	Title	Units
OIE 3020	Achieving Effective Operations	1/3
	Select two courses from the following: AE, BB, BME, CE (except 3022), CH, CHE, CS (except 3043), DS, ECE, ES (except 1000), GE, OIE, MA, ME, PH, RBE (except 3100)	2/3

Analytics Courses (3/3 unit)

OIE 3420 Quality Planning Design and Control; Select one course from: MIS 3720 Business Data Management, MIS 3787 Business Applications of Machine Learning, MIS 4084 Business Intelligence; Select one course from: BUS 2080 Data Analysis for Decision Making or OIE 2081 Introduction to Prescriptive Analytics, OIE 3460 Simulation Modeling and Analysis, OIE 3510 Stochastic Models, OIE 4430 Advanced Prescriptive Analytics: From Data to Impact.

Item #	Title	Units
OIE 3420	Quality Planning, Design and Control	1/3
	MIS 3720 or MIS 3787 or MIS 4084	1/3
	BUS 2080, OIE 2081, OIE 3460, OIE 3510, OIE 4430	1/3

Technical or Analytics Course (1/3 unit)

Select one additional course from remaining Technical or Analytics Courses.

Management Engineering Concentration Courses (6/3 Units)

Students selecting the Management Engineering Major must complete six courses from one of the concentrations as specified in the summary table for concentrations. Students may also work with their faculty advisor to create a custom MGE Program. Such custom programs must be approved by the advisor and the Business School's Undergraduate Policy and Curriculum Committee.

Biomedical Engineering:
ETR 1100 or MKT 3640 and five from the list below.

Item #	Title	Units
	ETR 1100 or MKT 3640	
BB 3101	Human Anatomy & Physiology: Movement and Communication	1/3
BB 3102	Human Anatomy & Physiology: Transport and Maintenance	1/3
BME 1001	Introduction to Biomedical Engineering	1/3
BME 2001	Introduction to Biomaterials	1/3
BME 2210	Biomedical Signals, Instruments and Measurements	1/3
BME 2211	Biomedical Data Analysis	1/3
BME 2502	Introduction to Biomechanics: Stress Analysis	1/3
BME 3111	Physiology and Engineering	1/3
BME 3300	Biomedical Engineering Design	1/3
BME 3610	Transport Analysis in Bioengineering	1/3

MGE MQP (3/3 Units)

The MQP must have a focus in the concentration area with an MQP advisor from the Business School.

Free Electives (4/3 Units)

Program Chart and/or Course Flow Chart

MANAGEMENT ENGINEERING
OVERVIEW OF DEGREE REQUIREMENTS

UNIVERSITY REQUIREMENTS
HUMANITIES AND ARTS (6/3 Units): 6 courses including Inquiry Seminar/Practicum
SOCIAL SCIENCE (2/3 Units): ECON 1110 or ECON 1120 or ECON 2910 One from DEV, ECON, ENV, GOV, PSY, SD, SOC, SS, STS or ID 2050
PHYSICAL EDUCATION (1/3 Units)
INTERACTIVE QUALIFYING PROJECT (3/3 Unit)-3rd Year

MATHEMATICS AND SCIENCE REQUIREMENTS
BASIC SCIENCE (2/3 Units) BB, CH, GE, PH
MATHEMATICS (4/3 Units) Calculus - MA 1021; MA 1022; Statistics - MA 2611; MA 2612
COMPUTER SCIENCE (1/3 Units): CS 1004 (recommended) or CS 1101 or CS 1102

CORE MANGEMENT ENGINEERING CURRICULUM (6/3 Units) 3 from Financial Courses and 3 Managerial courses at least 2 courses are 3000 or higher level.	
Financial Courses	**Managerial Courses**
1. ACC 2060 2. Any finance course FIN 1250, FIN 2070, FIN 3300 3. OIE 2850	1. Select any organizational behavior course (recommended OBC 1010) 2. Select any marketing course (recommended MKT 4030) 3. Select any course from: BUS 2020, MIS 3010, any course with an ETR, ETR or OBC prefix.

TECHNICAL AND ANALYTICS COURSES (6/3 Units) Minimum 3 courses from each type	
Technical Courses	**Analytics Courses**
1. OIE 3020 2. Select two courses from the following: AE, BB, BME, CE (except 3022), CH, CHE, CS (except 3043), DS, ECE, ES (except 1000), GE, OIE, MA, ME, PH, RBE (except 3100).	1. OIE 3420 2. Select one course from: MIS 3720, MIS 3787, MIS 4084 3. Select one course from: BUS 2080 or OIE 2081, OIE 3460, OIE 3510, OIE 4430.

TECHNICAL or ANALYTICS COURSES (1/3 Units) Select one from the remaining Technical or Analytics Elective courses.

MAJOR QUALIFYING PROJECT (3/3 Units) The MQP must have a focus in the concentration area with an MQP advisor from the Business School.

FREE ELECTIVES (4/3 Units)

SUMMARY TABLE

MANAGEMENT ENGINEERING CONCENTRATION COURSES 2023-24 (6/3 Units)

Select 5 courses from concentration + 1 from ETR 1100 or MKT 3640

Biomedical Engineering	Civil Engineering	Electrical and Computer Engineering	Industrial Engineering
1. ETR 1100 or MKT 3640 2. Select five courses from: BME 1001, BME 2001, BME 2210, BME 2211, BME 2502, BME 3300, BME 3111, BME 3610, BB 3101, BB 3102	1. ETR 1100 or MKT 3640 2. Select five courses from: AREN 2023, CE 1030, CE 2000, CE 2001, CE 2020, CE 3020, CE 3022, CE 3025, CE 3030, CE 3031, CE 3041, ES 3004	1. ETR 1100 or MKT 3640 2. Select five courses from: ECE 2010, ECE 2019, ECE 2029, ECE 2049, ECE 2112, ECE 2311, ECE 2312, ECE 2799	1. ETR 1100 or MKT 3640 2. Select five courses from: MIS 3720, OIE 2081, OIE 2600, OIE 3405, OIE 3410, OIE 3460, OIE 3510, OIE 4410, OIE 4430
Information Technology	**Manufacturing Engineering**	**Mechanical Engineering**	**Custom**
1. ETR 1100 or MKT 3640 2. MIS 3720 3. MIS 4720 4. Select three courses from: MIS 3787, MIS 4084, MIS 4741, CS 2119, CS 2102/2103, CS 2301/2303, CS 3041, DS 1010	1. ETR 1100 or MKT 3640 2. Select five courses from: ES 2001, ME 1800, ME 2820, ME 3320, ME 3820, ME 4718, ME 4810, ME 4813, ME 4814, ME 4815, ME 4821, ME 4875	1. ETR 1100 or MKT 3640 2. Select five courses from: ES 2001, ES 2501, ES 2502, ES 2503, ES 3001, ES 3003, ES 3004, ME 1800, ME 2300, ME 2820, ME 3820, ME 3901 or 3902, ME 4320, ME 4429, ME 4430	1. ETR 1100 or MKT 3640 2. Students with their advisor select a name for the custom concentration and five relevant STEM courses (typically selected from courses that satisfy the technical or analytical electives of the MGE degree). All custom concentrations must be approved by the Undergraduate Committee (UPCC) of the Business School.

Effective for AY 2023-24

Management Engineering Major with Concentration in Civil Engineering

Degree Type

Concentration

Educational Objectives

Objectives of the Management Engineering Major are:

- To prepare students for management challenges in key areas that increasingly require proficiency in the technical aspects of business such as production and service operations.
- To provide the knowledge and skills necessary to succeed professionally, including literacy in a technical field, a broad understanding of management issues, written communication, oral presentation, decision-making, and leadership skills required to create new and improved products, processes and control systems.
- To develop student abilities necessary for continued career growth including:
  - the ability to integrate theory and practice and to apply knowledge of technical issues with the foundations of management
  - the ability to integrate technology and change into existing organizations
  - the ability to think critically and analytically, to define and solve business problems, work in teams, and think globally; and
  - the ability to learn new skills in response to changing professional requirements.

Program Distribution Requirements for the Management Engineering Major

Mathematics and Science

Mathematics (4/3 units)

Mathematics must include 2/3 units of calculus and 2/3 units of statistics.

Item #	Title	Units
MA 1021	Calculus I	1/3
MA 1022	Calculus II	1/3
MA 2611	Applied Statistics I	1/3
MA 2612	Applied Statistics II	1/3

Computer Science (1/3 unit)

A minimum of 1/3 unit of Computer Science focused on programming. CS 1004, CS 1101, or CS 1102 is recommended. (CS 2022 and CS 3043 are not accepted.)

Item #	Title	Units
CS 1004	Introduction to Programming for Non-Majors	1/3
CS 1101	Introduction to Program Design	1/3
CS 1102	Accelerated Introduction to Program Design	1/3

Basic Science (2/3 unit)

Any course with prefix: BB, CH, GE, PH

Social Sciences (2/3 units)

ECON 1110 or ECON 1120 or ECON 2910/ETR 2910 and

ID 2050 or one from DEV, ECON, ENV, GOV, PSY, SD, SOC, SS, STS

Item #	Title	Units
	ECON 1110 or ECON 1120 or ECON 2910/ETR 2910	1/3
	ID 2050 or one from DEV, ECON, ENV, GOV, PSY, SD, SOC, SS, STS	1/3

Management Engineering Core Curriculum

Financial Courses (3/3 unit)*

ACC 2060: Financial Statements for Decision Making; Select one course from: FIN 1250 Personal Finance, FIN 2070 Fundamentals of Finance, FIN 3300 Finance & Technology (FinTech); OIE 2850 Engineering Economics.

*Two courses at 3,000 level or above required across Financial and Managerial courses.

Item #	Title	Units
ACC 2060	Financial Statements for Decision Making	1/3
	FIN 1250 or FIN 2070 or FIN 3300	
OIE 2850	Engineering Economics	1/3

Managerial Courses (3/3 unit)*

Select one organizational behavior course (Recommended OBC 1010 Leadership Practice); Select one marketing course (Recommended MKT 4030 Achieving Strategic Effectiveness); Select one course from BUS 2020 The Legal Environment of Business Decisions, MIS 3010 Creating Value through Innovation, any course with an ETR, MKT, or OBC prefix.

*Two courses at 3,000 level or above required across Financial and Managerial courses.

Item #	Title	Units
OBC 1010	Leadership Practice	1/3
MKT 4030	Achieving Strategic Effectiveness	1/3
	BUS 2020 or MIS 3010, ETR, MKT, OBC course	1/3

Technical Courses (3/3 unit)

OIE 3020 Achieving Effective Operations; Select two courses from the following: AE, BB, BME, CE (except 3022), CH, CHE, CS (except 3043), DS, ECE, ES (except 1000), GE, OIE, MA, ME, PH, RBE (except 3100).

Item #	Title	Units
OIE 3020	Achieving Effective Operations	1/3
	Select two courses from the following: AE, BB, BME, CE (except 3022), CH, CHE, CS (except 3043), DS, ECE, ES (except 1000), GE, OIE, MA, ME, PH, RBE (except 3100)	2/3

Analytics Courses (3/3 unit)

OIE 3420 Quality Planning Design and Control; Select one course from: MIS 3720 Business Data Management, MIS 3787 Business Applications of Machine Learning, MIS 4084 Business Intelligence; Select one course from: BUS 2080 Data Analysis for Decision Making or OIE 2081 Introduction to Prescriptive Analytics, OIE 3460 Simulation Modeling and Analysis, OIE 3510 Stochastic Models, OIE 4430 Advanced Prescriptive Analytics: From Data to Impact.

Item #	Title	Units
OIE 3420	Quality Planning, Design and Control	1/3
	MIS 3720 or MIS 3787 or MIS 4084	1/3
	BUS 2080, OIE 2081, OIE 3460, OIE 3510, OIE 4430	1/3

Technical or Analytics Course (1/3 unit)

Select one additional course from remaining Technical or Analytics Courses.

Management Engineering Concentration Courses (6/3 Units)

Students selecting the Management Engineering Major must complete six courses from one of the concentrations as specified in the summary table for concentrations. Students may also work with their faculty advisor to create a custom MGE Program. Such custom programs must be approved by the advisor and the Business School's Undergraduate Policy and Curriculum Committee.

Civil Engineering:

ETR 1100 or MKT 3640 and five from the list below

Item #	Title	Units
	ETR 1100 or MKT 3640	
AREN 2023	Introduction to Architectural Engineering Systems	1/3
CE 1030	Civil Engineering and Computer Fundamentals	1/3
CE 2000	Analytical Mechanics I	1/3
CE 2001	Analytical Mechanics II	1/3
CE 2020	Surveying	1/3
CE 3020	Project Management	1/3
CE 3022	Legal Aspects of Professional Practice	1/3
CE 3025	Project Evaluation	1/3
CE 3030	Fundamentals of Civil Engineering Autocad	1/3
CE 3031	Building Information Modeling: Software Tools and Principles	1/3
CE 3041	Soil Mechanics	1/3
ES 3004	Fluid Mechanics	1/3

MGE MQP (3/3 unit)

The MQP must have a focus in the concentration area with an MQP advisor from the Business School.

Free Electives (4/3 Units)

Program Chart and/or Course Flow Chart

MANAGEMENT ENGINEERING
OVERVIEW OF DEGREE REQUIREMENTS

UNIVERSITY REQUIREMENTS
HUMANITIES AND ARTS (6/3 Units): 6 courses including Inquiry Seminar/Practicum
SOCIAL SCIENCE (2/3 Units): ECON 1110 or ECON 1120 or ECON 2910 One from DEV, ECON, ENV, GOV, PSY, SD, SOC, SS, STS or ID 2050
PHYSICAL EDUCATION (1/3 Units)
INTERACTIVE QUALIFYING PROJECT (3/3 Unit)-3rd Year

MATHEMATICS AND SCIENCE REQUIREMENTS
BASIC SCIENCE (2/3 Units) BB, CH, GE, PH
MATHEMATICS (4/3 Units) Calculus - MA 1021; MA 1022; Statistics - MA 2611; MA 2612
COMPUTER SCIENCE (1/3 Units): CS 1004 (recommended) or CS 1101 or CS 1102

CORE MANGEMENT ENGINEERING CURRICULUM (6/3 Units) 3 from Financial Courses and 3 Managerial courses at least 2 courses are 3000 or higher level.	
Financial Courses	**Managerial Courses**
1. ACC 2060 2. Any finance course FIN 1250, FIN 2070, FIN 3300 3. OIE 2850	1. Select any organizational behavior course (recommended OBC 1010) 2. Select any marketing course (recommended MKT 4030) 3. Select any course from: BUS 2020, MIS 3010, any course with an ETR, ETR or OBC prefix.

TECHNICAL AND ANALYTICS COURSES (6/3 Units) Minimum 3 courses from each type	
Technical Courses	**Analytics Courses**
1. OIE 3020 2. Select two courses from the following: AE, BB, BME, CE (except 3022), CH, CHE, CS (except 3043), DS, ECE, ES (except 1000), GE, OIE, MA, ME, PH, RBE (except 3100).	1. OIE 3420 2. Select one course from: MIS 3720, MIS 3787, MIS 4084 3. Select one course from: BUS 2080 or OIE 2081, OIE 3460, OIE 3510, OIE 4430.

TECHNICAL or ANALYTICS COURSES (1/3 Units) Select one from the remaining Technical or Analytics Elective courses.

MAJOR QUALIFYING PROJECT (3/3 Units) The MQP must have a focus in the concentration area with an MQP advisor from the Business School.

FREE ELECTIVES (4/3 Units)

SUMMARY TABLE

MANAGEMENT ENGINEERING CONCENTRATION COURSES 2023-24 (6/3 Units)

Select 5 courses from concentration + 1 from ETR 1100 or MKT 3640

Biomedical Engineering	Civil Engineering	Electrical and Computer Engineering	Industrial Engineering
1. ETR 1100 or MKT 3640 2. Select five courses from: BME 1001, BME 2001, BME 2210, BME 2211, BME 2502, BME 3300, BME 3111, BME 3610, BB 3101, BB 3102	1. ETR 1100 or MKT 3640 2. Select five courses from: AREN 2023, CE 1030, CE 2000, CE 2001, CE 2020, CE 3020, CE 3022, CE 3025, CE 3030, CE 3031, CE 3041, ES 3004	1. ETR 1100 or MKT 3640 2. Select five courses from: ECE 2010, ECE 2019, ECE 2029, ECE 2049, ECE 2112, ECE 2311, ECE 2312, ECE 2799	1. ETR 1100 or MKT 3640 2. Select five courses from: MIS 3720, OIE 2081, OIE 2600, OIE 3405, OIE 3410, OIE 3460, OIE 3510, OIE 4410, OIE 4430
Information Technology	**Manufacturing Engineering**	**Mechanical Engineering**	**Custom**
1. ETR 1100 or MKT 3640 2. MIS 3720 3. MIS 4720 4. Select three courses from: MIS 3787, MIS 4084, MIS 4741, CS 2119, CS 2102/2103, CS 2301/2303, CS 3041, DS 1010	1. ETR 1100 or MKT 3640 2. Select five courses from: ES 2001, ME 1800, ME 2820, ME 3320, ME 3820, ME 4718, ME 4810, ME 4813, ME 4814, ME 4815, ME 4821, ME 4875	1. ETR 1100 or MKT 3640 2. Select five courses from: ES 2001, ES 2501, ES 2502, ES 2503, ES 3001, ES 3003, ES 3004, ME 1800, ME 2300, ME 2820, ME 3820, ME 3901 or 3902, ME 4320, ME 4429, ME 4430	1. ETR 1100 or MKT 3640 2. Students with their advisor select a name for the custom concentration and five relevant STEM courses (typically selected from courses that satisfy the technical or analytical electives of the MGE degree). All custom concentrations must be approved by the Undergraduate Committee (UPCC) of the Business School.

Effective for AY 2023-24

Management Engineering Major with Concentration in Electrical and Computer Engineering

Degree Type

Concentration

Educational Objectives

Objectives of the Management Engineering Major are:

- To prepare students for management challenges in key areas that increasingly require proficiency in the technical aspects of business such as production and service operations.
- To provide the knowledge and skills necessary to succeed professionally, including literacy in a technical field, a broad understanding of management issues, written communication, oral presentation, decision-making, and leadership skills required to create new and improved products, processes and control systems.
- To develop student abilities necessary for continued career growth including:
  - the ability to integrate theory and practice and to apply knowledge of technical issues with the foundations of management
  - the ability to integrate technology and change into existing organizations
  - the ability to think critically and analytically, to define and solve business problems, work in teams, and think globally; and
  - the ability to learn new skills in response to changing professional requirements.

Program Distribution Requirements for the Management Engineering Major

Mathematics and Science

Mathematics (4/3 units)

Mathematics must include 2/3 units of calculus and 2/3 units of statistics.

Item #	Title	Units
MA 1021	Calculus I	1/3
MA 1022	Calculus II	1/3
MA 2611	Applied Statistics I	1/3
MA 2612	Applied Statistics II	1/3

Computer Science (1/3 unit)

A minimum of 1/3 unit of Computer Science focused on programming. CS 1004, CS 1101, or CS 1102 is recommended. (CS 2022 and CS 3043 are not accepted.)

Item #	Title	Units
CS 1004	Introduction to Programming for Non-Majors	1/3
CS 1101	Introduction to Program Design	1/3
CS 1102	Accelerated Introduction to Program Design	1/3

Basic Science (2/3 unit)

Any course with prefix: BB, CH, GE, PH

Social Sciences (2/3 units)

ECON 1110 or ECON 1120 or ECON 2910/ETR 2910 and

ID 2050 or one from DEV, ECON, ENV, GOV, PSY, SD, SOC, SS, STS

Item #	Title	Units
	ECON 1110 or ECON 1120 or ECON 2910/ETR 2910	1/3
	ID 2050 or one from DEV, ECON, ENV, GOV, PSY, SD, SOC, SS, STS	1/3

Management Engineering Core Curriculum

Financial Courses (3/3 unit)*

ACC 2060: Financial Statements for Decision Making; Select one course from: FIN 1250 Personal Finance, FIN 2070 Fundamentals of Finance, FIN 3300 Finance & Technology (FinTech); OIE 2850 Engineering Economics.

*Two courses at 3,000 level or above required across Financial and Managerial courses.

Item #	Title	Units
ACC 2060	Financial Statements for Decision Making	1/3
	FIN 1250 or FIN 2070 or FIN 3300	
OIE 2850	Engineering Economics	1/3

Managerial Courses (3/3 unit)*

Select one organizational behavior course (Recommended OBC 1010 Leadership Practice); Select one marketing course (Recommended MKT 4030 Achieving Strategic Effectiveness); Select one course from BUS 2020 The Legal Environment of Business Decisions, MIS 3010 Creating Value through Innovation, any course with an ETR, MKT, or OBC prefix.

*Two courses at 3,000 level or above required across Financial and Managerial courses.

Item #	Title	Units
OBC 1010	Leadership Practice	1/3
MKT 4030	Achieving Strategic Effectiveness	1/3
	BUS 2020 or MIS 3010, ETR, MKT, OBC course	1/3

Technical Courses (3/3 unit)

OIE 3020 Achieving Effective Operations; Select two courses from the following: AE, BB, BME, CE (except 3022), CH, CHE, CS (except 3043), DS, ECE, ES (except 1000), GE, OIE, MA, ME, PH, RBE (except 3100).

Item #	Title	Units
OIE 3020	Achieving Effective Operations	1/3
	Select two courses from the following: AE, BB, BME, CE (except 3022), CH, CHE, CS (except 3043), DS, ECE, ES (except 1000), GE, OIE, MA, ME, PH, RBE (except 3100)	2/3

Analytics Courses (3/3 unit)

OIE 3420 Quality Planning Design and Control; Select one course from: MIS 3720 Business Data Management, MIS 3787 Business Applications of Machine Learning, MIS 4084 Business Intelligence; Select one course from: BUS 2080 Data Analysis for Decision Making or OIE 2081 Introduction to Prescriptive Analytics, OIE 3460 Simulation Modeling and Analysis, OIE 3510 Stochastic Models, OIE 4430 Advanced Prescriptive Analytics: From Data to Impact.

Item #	Title	Units
OIE 3420	Quality Planning, Design and Control	1/3
	MIS 3720 or MIS 3787 or MIS 4084	1/3
	BUS 2080, OIE 2081, OIE 3460, OIE 3510, OIE 4430	1/3

Technical or Analytics Course (1/3 unit)
Select one additional course from remaining Technical or Analytics Courses.

Management Engineering Concentration Courses (6/3 Units)

Students selecting the Management Engineering Major must complete six courses from one of the concentrations as specified in the summary table for concentrations. Students may also work with their faculty advisor to create a custom MGE Program. Such custom programs must be approved by the advisor and the Business School's Undergraduate Policy and Curriculum Committee.

Electrical and Computer Engineering:
ETR 1100 or MKT 3640 and five from the list below

Item #	Title	Units
	ETR 1100 or MKT 3640	
ECE 2010	Introduction to Electrical and Computer Engineering	1/3
ECE 2019	Sensors, Circuits, and Systems	1/3
ECE 2029	Introduction to Digital Circuit Design	1/3
ECE 2049	Embedded Computing in Engineering Design	1/3
ECE 2112	Electromagnetic Fields	1/3
ECE 2311	Continuous-Time Signal and System Analysis	1/3
ECE 2312	Discrete-Time Signal and System Analysis	1/3
ECE 2799	Electrical and Computer Engineering Design	1/3

MGE MQP (3/3 Units)

The MQP must have a focus in the concentration area with an MQP advisor from the Business School.

Free Electives (4/3 Units)

Program Chart and/or Course Flow Chart

MANAGEMENT ENGINEERING
OVERVIEW OF DEGREE REQUIREMENTS

UNIVERSITY REQUIREMENTS
HUMANITIES AND ARTS (6/3 Units): 6 courses including Inquiry Seminar/Practicum
SOCIAL SCIENCE (2/3 Units): ECON 1110 or ECON 1120 or ECON 2910 One from DEV, ECON, ENV, GOV, PSY, SD, SOC, SS, STS or ID 2050
PHYSICAL EDUCATION (1/3 Units)
INTERACTIVE QUALIFYING PROJECT (3/3 Unit)-3rd Year

MATHEMATICS AND SCIENCE REQUIREMENTS
BASIC SCIENCE (2/3 Units) BB, CH, GE, PH
MATHEMATICS (4/3 Units) Calculus - MA 1021; MA 1022; Statistics - MA 2611; MA 2612
COMPUTER SCIENCE (1/3 Units): CS 1004 (recommended) or CS 1101 or CS 1102

CORE MANGEMENT ENGINEERING CURRICULUM (6/3 Units) **3 from Financial Courses and 3 Managerial courses at least 2 courses are 3000 or higher level.**	
Financial Courses	**Managerial Courses**
1. ACC 2060 2. Any finance course FIN 1250, FIN 2070, FIN 3300 3. OIE 2850	1. Select any organizational behavior course (recommended OBC 1010) 2. Select any marketing course (recommended MKT 4030) 3. Select any course from: BUS 2020, MIS 3010, any course with an ETR, ETR or OBC prefix.

TECHNICAL AND ANALYTICS COURSES (6/3 Units) **Minimum 3 courses from each type**	
Technical Courses	**Analytics Courses**
1. OIE 3020 2. Select two courses from the following: AE, BB, BME, CE (except 3022), CH, CHE, CS (except 3043), DS, ECE, ES (except 1000), GE, OIE, MA, ME, PH, RBE (except 3100).	1. OIE 3420 2. Select one course from: MIS 3720, MIS 3787, MIS 4084 3. Select one course from: BUS 2080 or OIE 2081, OIE 3460, OIE 3510, OIE 4430.

TECHNICAL or ANALYTICS COURSES (1/3 Units) **Select one from the remaining Technical or Analytics Elective courses.**

MAJOR QUALIFYING PROJECT (3/3 Units) **The MQP must have a focus in the concentration area with an MQP advisor from the Business School.**

FREE ELECTIVES (4/3 Units)

SUMMARY TABLE

MANAGEMENT ENGINEERING CONCENTRATION COURSES 2023-24 (6/3 Units)

Select 5 courses from concentration + 1 from ETR 1100 or MKT 3640

Biomedical Engineering	Civil Engineering	Electrical and Computer Engineering	Industrial Engineering
1. ETR 1100 or MKT 3640 2. Select five courses from: BME 1001, BME 2001, BME 2210, BME 2211, BME 2502, BME 3300, BME 3111, BME 3610, BB 3101, BB 3102	1. ETR 1100 or MKT 3640 2. Select five courses from: AREN 2023, CE 1030, CE 2000, CE 2001, CE 2020, CE 3020, CE 3022, CE 3025, CE 3030, CE 3031, CE 3041, ES 3004	1. ETR 1100 or MKT 3640 2. Select five courses from: ECE 2010, ECE 2019, ECE 2029, ECE 2049, ECE 2112, ECE 2311, ECE 2312, ECE 2799	1. ETR 1100 or MKT 3640 2. Select five courses from: MIS 3720, OIE 2081, OIE 2600, OIE 3405, OIE 3410, OIE 3460, OIE 3510, OIE 4410, OIE 4430
Information Technology	**Manufacturing Engineering**	**Mechanical Engineering**	**Custom**
1. ETR 1100 or MKT 3640 2. MIS 3720 3. MIS 4720 4. Select three courses from: MIS 3787, MIS 4084, MIS 4741, CS 2119, CS 2102/2103, CS 2301/2303, CS 3041, DS 1010	1. ETR 1100 or MKT 3640 2. Select five courses from: ES 2001, ME 1800, ME 2820, ME 3320, ME 3820, ME 4718, ME 4810, ME 4813, ME 4814, ME 4815, ME 4821, ME 4875	1. ETR 1100 or MKT 3640 2. Select five courses from: ES 2001, ES 2501, ES 2502, ES 2503, ES 3001, ES 3003, ES 3004, ME 1800, ME 2300, ME 2820, ME 3820, ME 3901 or 3902, ME 4320, ME 4429, ME 4430	1. ETR 1100 or MKT 3640 2. Students with their advisor select a name for the custom concentration and five relevant STEM courses (typically selected from courses that satisfy the technical or analytical electives of the MGE degree). All custom concentrations must be approved by the Undergraduate Committee (UPCC) of the Business School.

Effective for AY 2023-24

Management Engineering Major with Concentration in Industrial Engineering

Degree Type

Concentration

Educational Objectives

Objectives of the Management Engineering Major are:

- To prepare students for management challenges in key areas that increasingly require proficiency in the technical aspects of business such as production and service operations.
- To provide the knowledge and skills necessary to succeed professionally, including literacy in a technical field, a broad understanding of management issues, written communication, oral presentation, decision-making, and leadership skills required to create new and improved products, processes and control systems.
- To develop student abilities necessary for continued career growth including:
  - the ability to integrate theory and practice and to apply knowledge of technical issues with the foundations of management
  - the ability to integrate technology and change into existing organizations
  - the ability to think critically and analytically, to define and solve business problems, work in teams, and think globally; and
  - the ability to learn new skills in response to changing professional requirements.

Program Distribution Requirements for the Management Engineering Major

Mathematics and Science

Mathematics (4/3 units)

Mathematics must include 2/3 units of calculus and 2/3 units of statistics.

Item #	Title	Units
MA 1021	Calculus I	1/3
MA 1022	Calculus II	1/3
MA 2611	Applied Statistics I	1/3
MA 2612	Applied Statistics II	1/3

Computer Science (1/3 unit)

A minimum of 1/3 unit of Computer Science focused on programming. CS 1004, CS 1101, or CS 1102 is recommended. (CS 2022 and CS 3043 are not accepted.)

Item #	Title	Units
CS 1004	Introduction to Programming for Non-Majors	1/3
CS 1101	Introduction to Program Design	1/3
CS 1102	Accelerated Introduction to Program Design	1/3

Basic Science (2/3 unit)

Any course with prefix: BB, CH, GE, PH

Social Sciences (2/3 units)

ECON 1110 or ECON 1120 or ECON 2910/ETR 2910 and

ID 2050 or one from DEV, ECON, ENV, GOV, PSY, SD, SOC, SS, STS

Item #	Title	Units
	ECON 1110 or ECON 1120 or ECON 2910/ETR 2910	1/3
	ID 2050 or one from DEV, ECON, ENV, GOV, PSY, SD, SOC, SS, STS	1/3

Management Engineering Core Curriculum

Financial Courses (3/3 unit)*

ACC 2060: Financial Statements for Decision Making; Select one course from: FIN 1250 Personal Finance, FIN 2070 Fundamentals of Finance, FIN 3300 Finance & Technology (FinTech); OIE 2850 Engineering Economics.

*Two courses at 3,000 level or above required across Financial and Managerial courses.

Item #	Title	Units
ACC 2060	Financial Statements for Decision Making	1/3
	FIN 1250 or FIN 2070 or FIN 3300	
OIE 2850	Engineering Economics	1/3

Managerial Courses (3/3 unit)*

Select one organizational behavior course (Recommended OBC 1010 Leadership Practice); Select one marketing course (Recommended MKT 4030 Achieving Strategic Effectiveness); Select one course from BUS 2020 The Legal Environment of Business Decisions, MIS 3010 Creating Value through Innovation, any course with an ETR, MKT, or OBC prefix.

*Two courses at 3,000 level or above required across Financial and Managerial courses.

Item #	Title	Units
OBC 1010	Leadership Practice	1/3
MKT 4030	Achieving Strategic Effectiveness	1/3
	BUS 2020 or MIS 3010, ETR, MKT, OBC course	1/3

Technical Courses (3/3 unit)

OIE 3020 Achieving Effective Operations; Select two courses from the following: AE, BB, BME, CE (except 3022), CH, CHE, CS (except 3043), DS, ECE, ES (except 1000), GE, OIE, MA, ME, PH, RBE (except 3100).

Item #	Title	Units
OIE 3020	Achieving Effective Operations	1/3
	Select two courses from the following: AE, BB, BME, CE (except 3022), CH, CHE, CS (except 3043), DS, ECE, ES (except 1000), GE, OIE, MA, ME, PH, RBE (except 3100)	2/3

Analytics Courses (3/3 unit)

OIE 3420 Quality Planning Design and Control; Select one course from: MIS 3720 Business Data Management, MIS 3787 Business Applications of Machine Learning, MIS 4084 Business Intelligence; Select one course from: BUS 2080 Data Analysis for Decision Making or OIE 2081 Introduction to Prescriptive Analytics, OIE 3460 Simulation Modeling and Analysis, OIE 3510 Stochastic Models, OIE 4430 Advanced Prescriptive Analytics: From Data to Impact.

Item #	Title	Units
OIE 3420	Quality Planning, Design and Control	1/3
	MIS 3720 or MIS 3787 or MIS 4084	1/3
	BUS 2080, OIE 2081, OIE 3460, OIE 3510, OIE 4430	1/3

Technical or Analytics Course (1/3 unit)

Select one additional course from remaining Technical or Analytics Courses.

Management Engineering Concentration Courses (6/3 Units)

Students selecting the Management Engineering Major must complete six courses from one of the concentrations as specified in the summary table for concentrations. Students may also work with their faculty advisor to create a custom MGE Program. Such custom programs must be approved by the advisor and the Business School's Undergraduate Policy and Curriculum Committee.

Industrial Engineering:

ETR 1100 or MKT 3640 and five from the list below.

Item #	Title	Units
	ETR 1100 or MKT 3640	
MIS 3720	Business Data Management	1/3
OIE 2081	Introduction to Prescriptive Analytics	1/3
OIE 2600	Scripting for Process and Productivity Improvement	1/3
OIE 3405	Work Systems and Facilities Planning	1/3
OIE 3410	Materials Management in Supply Chains	1/3
OIE 3460	Simulation Modeling and Analysis	1/3
OIE 3510	Stochastic Models	1/3
OIE 4410	Case Studies in Industrial Engineering	1/3
OIE 4430	Advanced Prescriptive Analytics: From Data to Impact	1/3

MGE MQP (3/3 Units)

The MQP must have a focus in the concentration area with an MQP advisor from the Business School.

Free Electives (4/3 Units)

Program Chart and/or Course Flow Chart

MANAGEMENT ENGINEERING
OVERVIEW OF DEGREE REQUIREMENTS

UNIVERSITY REQUIREMENTS
HUMANITIES AND ARTS (6/3 Units): 6 courses including Inquiry Seminar/Practicum
SOCIAL SCIENCE (2/3 Units): ECON 1110 or ECON 1120 or ECON 2910 One from DEV, ECON, ENV, GOV, PSY, SD, SOC, SS, STS or ID 2050
PHYSICAL EDUCATION (1/3 Units)
INTERACTIVE QUALIFYING PROJECT (3/3 Unit)-3rd Year

MATHEMATICS AND SCIENCE REQUIREMENTS
BASIC SCIENCE (2/3 Units) BB, CH, GE, PH
MATHEMATICS (4/3 Units) Calculus - MA 1021; MA 1022; Statistics - MA 2611; MA 2612
COMPUTER SCIENCE (1/3 Units): CS 1004 (recommended) or CS 1101 or CS 1102

CORE MANGEMENT ENGINEERING CURRICULUM (6/3 Units) **3 from Financial Courses and 3 Managerial courses at least 2 courses are 3000 or higher level.**	
Financial Courses	**Managerial Courses**
1. ACC 2060 2. Any finance course FIN 1250, FIN 2070, FIN 3300 3. OIE 2850	1. Select any organizational behavior course (recommended OBC 1010) 2. Select any marketing course (recommended MKT 4030) 3. Select any course from: BUS 2020, MIS 3010, any course with an ETR, ETR or OBC prefix.

TECHNICAL AND ANALYTICS COURSES (6/3 Units) **Minimum 3 courses from each type**	
Technical Courses	**Analytics Courses**
1. OIE 3020 2. Select two courses from the following: AE, BB, BME, CE (except 3022), CH, CHE, CS (except 3043), DS, ECE, ES (except 1000), GE, OIE, MA, ME, PH, RBE (except 3100).	1. OIE 3420 2. Select one course from: MIS 3720, MIS 3787, MIS 4084 3. Select one course from: BUS 2080 or OIE 2081, OIE 3460, OIE 3510, OIE 4430.

TECHNICAL or ANALYTICS COURSES (1/3 Units) **Select one from the remaining Technical or Analytics Elective courses.**

MAJOR QUALIFYING PROJECT (3/3 Units) **The MQP must have a focus in the concentration area with an MQP advisor from the Business School.**

FREE ELECTIVES (4/3 Units)

SUMMARY TABLE

MANAGEMENT ENGINEERING CONCENTRATION COURSES 2023-24 (6/3 Units)

Select 5 courses from concentration + 1 from ETR 1100 or MKT 3640

Biomedical Engineering	Civil Engineering	Electrical and Computer Engineering	Industrial Engineering
1. ETR 1100 or MKT 3640 2. Select five courses from: BME 1001, BME 2001, BME 2210, BME 2211, BME 2502, BME 3300, BME 3111, BME 3610, BB 3101, BB 3102	1. ETR 1100 or MKT 3640 2. Select five courses from: AREN 2023, CE 1030, CE 2000, CE 2001, CE 2020, CE 3020, CE 3022, CE 3025, CE 3030, CE 3031, CE 3041, ES 3004	1. ETR 1100 or MKT 3640 2. Select five courses from: ECE 2010, ECE 2019, ECE 2029, ECE 2049, ECE 2112, ECE 2311, ECE 2312, ECE 2799	1. ETR 1100 or MKT 3640 2. Select five courses from: MIS 3720, OIE 2081, OIE 2600, OIE 3405, OIE 3410, OIE 3460, OIE 3510, OIE 4410, OIE 4430
Information Technology	**Manufacturing Engineering**	**Mechanical Engineering**	**Custom**
1. ETR 1100 or MKT 3640 2. MIS 3720 3. MIS 4720 4. Select three courses from: MIS 3787, MIS 4084, MIS 4741, CS 2119, CS 2102/2103, CS 2301/2303, CS 3041, DS 1010	1. ETR 1100 or MKT 3640 2. Select five courses from: ES 2001, ME 1800, ME 2820, ME 3320, ME 3820, ME 4718, ME 4810, ME 4813, ME 4814, ME 4815, ME 4821, ME 4875	1. ETR 1100 or MKT 3640 2. Select five courses from: ES 2001, ES 2501, ES 2502, ES 2503, ES 3001, ES 3003, ES 3004, ME 1800, ME 2300, ME 2820, ME 3820, ME 3901 or 3902, ME 4320, ME 4429, ME 4430	1. ETR 1100 or MKT 3640 2. Students with their advisor select a name for the custom concentration and five relevant STEM courses (typically selected from courses that satisfy the technical or analytical electives of the MGE degree). All custom concentrations must be approved by the Undergraduate Committee (UPCC) of the Business School.

Effective for AY 2023-24

Management Engineering Major with Concentration in Information Technology

Degree Type

Concentration

Educational Objectives

Objectives of the Management Engineering Major are:

- To prepare students for management challenges in key areas that increasingly require proficiency in the technical aspects of business such as production and service operations.
- To provide the knowledge and skills necessary to succeed professionally, including literacy in a technical field, a broad understanding of management issues, written communication, oral presentation, decision-making, and leadership skills required to create new and improved products, processes and control systems.
- To develop student abilities necessary for continued career growth including:
  - the ability to integrate theory and practice and to apply knowledge of technical issues with the foundations of management
  - the ability to integrate technology and change into existing organizations
  - the ability to think critically and analytically, to define and solve business problems, work in teams, and think globally; and
  - the ability to learn new skills in response to changing professional requirements.

Program Distribution Requirements for the Management Engineering Major

Mathematics and Science

Mathematics (4/3 units)

Mathematics must include 2/3 units of calculus and 2/3 units of statistics.

Item #	Title	Units
MA 1021	Calculus I	1/3
MA 1022	Calculus II	1/3
MA 2611	Applied Statistics I	1/3
MA 2612	Applied Statistics II	1/3

Computer Science (1/3 unit)

A minimum of 1/3 unit of Computer Science focused on programming. CS 1004, CS 1101, or CS 1102 is recommended. (CS 2022 and CS 3043 are not accepted.)

Item #	Title	Units
CS 1004	Introduction to Programming for Non-Majors	1/3
CS 1101	Introduction to Program Design	1/3
CS 1102	Accelerated Introduction to Program Design	1/3

Basic Science (2/3 unit)

Any course with prefix: BB, CH, GE, PH

Social Sciences (2/3 units)

ECON 1110, ECON 1110 or ECON 1120 or ECON 2910/ETR 2910 and

ID 2050 or one from DEV, ECON, ENV, GOV, PSY, SD, SOC, SS, STS

Item #	Title	Units
	ECON 1110 or ECON 1120 or ECON 2910/ETR 2910	1/3
	ID 2050 or one from DEV, ECON, ENV, GOV, PSY, SD, SOC, SS, STS	1/3

Management Engineering Core Curriculum

Financial Courses (3/3 unit)*

ACC 2060: Financial Statements for Decision Making; Select one course from: FIN 1250 Personal Finance, FIN 2070 Fundamentals of Finance, FIN 3300 Finance & Technology (FinTech); OIE 2850 Engineering Economics.

*Two courses at 3,000 level or above required across Financial and Managerial courses.

Item #	Title	Units
ACC 2060	Financial Statements for Decision Making	1/3
	FIN 1250 or FIN 2070 or FIN 3300	
OIE 2850	Engineering Economics	1/3

Managerial Courses (3/3 unit)*

Select one organizational behavior course (Recommended OBC 1010 Leadership Practice); Select one marketing course (Recommended MKT 4030 Achieving Strategic Effectiveness); Select one course from BUS 2020 The Legal Environment of Business Decisions, MIS 3010 Creating Value through Innovation, any course with an ETR, MKT, or OBC prefix.

*Two courses at 3,000 level or above required across Financial and Managerial courses.

Item #	Title	Units
OBC 1010	Leadership Practice	1/3
MKT 4030	Achieving Strategic Effectiveness	1/3
	BUS 2020 or MIS 3010, ETR, MKT, OBC course	1/3

Technical Courses (3/3 unit)

OIE 3020 Achieving Effective Operations; Select two courses from the following: AE, BB, BME, CE (except 3022), CH, CHE, CS (except 3043), DS, ECE, ES (except 1000), GE, OIE, MA, ME, PH, RBE (except 3100).

Item #	Title	Units
OIE 3020	Achieving Effective Operations	1/3
	Select two courses from the following: AE, BB, BME, CE (except 3022), CH, CHE, CS (except 3043), DS, ECE, ES (except 1000), GE, OIE, MA, ME, PH, RBE (except 3100)	2/3

Analytics Courses (3/3 unit)

OIE 3420 Quality Planning Design and Control; Select one course from: MIS 3720 Business Data Management, MIS 3787 Business Applications of Machine Learning, MIS 4084 Business Intelligence; Select one course from: BUS 2080 Data Analysis for Decision Making or OIE 2081 Introduction to Prescriptive Analytics, OIE 3460 Simulation Modeling and Analysis, OIE 3510 Stochastic Models, OIE 4430 Advanced Prescriptive Analytics: From Data to Impact.

Item #	Title	Units
OIE 3420	Quality Planning, Design and Control	1/3
	MIS 3720 or MIS 3787 or MIS 4084	1/3
	BUS 2080, OIE 2081, OIE 3460, OIE 3510, OIE 4430	1/3

Technical or Analytics Course (1/3 unit)

Select one additional course from remaining Technical or Analytics Courses.

Management Engineering Concentration Courses (6/3 Units)

Students selecting the Management Engineering Major must complete six courses from one of the concentrations as specified in the summary table for concentrations. Students may also work with their faculty advisor to create a custom MGE Program. Such custom programs must be approved by the advisor and the Business School's Undergraduate Policy and Curriculum Committee.

Information Technology:

ETR 1100 or MKT 3640, MIS 3720, MIS 4720 and three the list below.

Item #	Title	Units
	ETR 1100 or MKT 3640	
MIS 3720	Business Data Management	1/3
MIS 4720	Systems Analysis and Design	1/3

Select three more from list below.

Item #	Title	Units
CS 2102	Object-Oriented Design Concepts	1/3
CS 2119	Application Building with Object-Oriented Concepts	1/3
CS 2301	Systems Programming for Non-Majors	1/3
CS 2303	Systems Programming Concepts	1/3
CS 3041	Human-Computer Interaction	1/3
DS 1010	Data Science I: Introduction to Data Science	1/3
MIS 3787	Business Applications of Machine Learning	1/3
MIS 4084	Business Intelligence	1/3
MIS 4741	User Experience and Design	1/3

MGE MQP (3/3 Units)

The MQP must have a focus in the concentration area with an MQP advisor from the Business School.

Free Electives (4/3 Units)

Program Chart and/or Course Flow Chart

MANAGEMENT ENGINEERING
OVERVIEW OF DEGREE REQUIREMENTS

UNIVERSITY REQUIREMENTS
HUMANITIES AND ARTS (6/3 Units): 6 courses including Inquiry Seminar/Practicum
SOCIAL SCIENCE (2/3 Units): ECON 1110 or ECON 1120 or ECON 2910 One from DEV, ECON, ENV, GOV, PSY, SD, SOC, SS, STS or ID 2050
PHYSICAL EDUCATION (1/3 Units)
INTERACTIVE QUALIFYING PROJECT (3/3 Unit)-3rd Year

MATHEMATICS AND SCIENCE REQUIREMENTS
BASIC SCIENCE (2/3 Units) BB, CH, GE, PH
MATHEMATICS (4/3 Units) Calculus - MA 1021; MA 1022; Statistics - MA 2611; MA 2612
COMPUTER SCIENCE (1/3 Units): CS 1004 (recommended) or CS 1101 or CS 1102

CORE MANGEMENT ENGINEERING CURRICULUM (6/3 Units) 3 from Financial Courses and 3 Managerial courses at least 2 courses are 3000 or higher level.	
Financial Courses	**Managerial Courses**
1. ACC 2060 2. Any finance course FIN 1250, FIN 2070, FIN 3300 3. OIE 2850	1. Select any organizational behavior course (recommended OBC 1010) 2. Select any marketing course (recommended MKT 4030) 3. Select any course from: BUS 2020, MIS 3010, any course with an ETR, ETR or OBC prefix.

TECHNICAL AND ANALYTICS COURSES (6/3 Units) Minimum 3 courses from each type	
Technical Courses	**Analytics Courses**
1. OIE 3020 2. Select two courses from the following: AE, BB, BME, CE (except 3022), CH, CHE, CS (except 3043), DS, ECE, ES (except 1000), GE, OIE, MA, ME, PH, RBE (except 3100).	1. OIE 3420 2. Select one course from: MIS 3720, MIS 3787, MIS 4084 3. Select one course from: BUS 2080 or OIE 2081, OIE 3460, OIE 3510, OIE 4430.

TECHNICAL or ANALYTICS COURSES (1/3 Units) Select one from the remaining Technical or Analytics Elective courses.

MAJOR QUALIFYING PROJECT (3/3 Units) The MQP must have a focus in the concentration area with an MQP advisor from the Business School.

FREE ELECTIVES (4/3 Units)

SUMMARY TABLE

MANAGEMENT ENGINEERING CONCENTRATION COURSES 2023-24 (6/3 Units)

Select 5 courses from concentration + 1 from ETR 1100 or MKT 3640

Biomedical Engineering	Civil Engineering	Electrical and Computer Engineering	Industrial Engineering
1. ETR 1100 or MKT 3640 2. Select five courses from: BME 1001, BME 2001, BME 2210, BME 2211, BME 2502, BME 3300, BME 3111, BME 3610, BB 3101, BB 3102	1. ETR 1100 or MKT 3640 2. Select five courses from: AREN 2023, CE 1030, CE 2000, CE 2001, CE 2020, CE 3020, CE 3022, CE 3025, CE 3030, CE 3031, CE 3041, ES 3004	1. ETR 1100 or MKT 3640 2. Select five courses from: ECE 2010, ECE 2019, ECE 2029, ECE 2049, ECE 2112, ECE 2311, ECE 2312, ECE 2799	1. ETR 1100 or MKT 3640 2. Select five courses from: MIS 3720, OIE 2081, OIE 2600, OIE 3405, OIE 3410, OIE 3460, OIE 3510, OIE 4410, OIE 4430
Information Technology	**Manufacturing Engineering**	**Mechanical Engineering**	**Custom**
1. ETR 1100 or MKT 3640 2. MIS 3720 3. MIS 4720 4. Select three courses from: MIS 3787, MIS 4084, MIS 4741, CS 2119, CS 2102/2103, CS 2301/2303, CS 3041, DS 1010	1. ETR 1100 or MKT 3640 2. Select five courses from: ES 2001, ME 1800, ME 2820, ME 3320, ME 3820, ME 4718, ME 4810, ME 4813, ME 4814, ME 4815, ME 4821, ME 4875	1. ETR 1100 or MKT 3640 2. Select five courses from: ES 2001, ES 2501, ES 2502, ES 2503, ES 3001, ES 3003, ES 3004, ME 1800, ME 2300, ME 2820, ME 3820, ME 3901 or 3902, ME 4320, ME 4429, ME 4430	1. ETR 1100 or MKT 3640 2. Students with their advisor select a name for the custom concentration and five relevant STEM courses (typically selected from courses that satisfy the technical or analytical electives of the MGE degree). All custom concentrations must be approved by the Undergraduate Committee (UPCC) of the Business School.

Effective for AY 2023-24

Management Engineering Major with Concentration in Manufacturing Engineering

Degree Type

Concentration

Educational Objectives

Objectives of the Management Engineering Major are:

- To prepare students for management challenges in key areas that increasingly require proficiency in the technical aspects of business such as production and service operations.
- To provide the knowledge and skills necessary to succeed professionally, including literacy in a technical field, a broad understanding of management issues, written communication, oral presentation, decision-making, and leadership skills required to create new and improved products, processes and control systems.
- To develop student abilities necessary for continued career growth including:
  - the ability to integrate theory and practice and to apply knowledge of technical issues with the foundations of management
  - the ability to integrate technology and change into existing organizations
  - the ability to think critically and analytically, to define and solve business problems, work in teams, and think globally; and
  - the ability to learn new skills in response to changing professional requirements.

Program Distribution Requirements for the Management Engineering Major

Mathematics and Science

Mathematics (4/3 units)

Mathematics must include 2/3 units of calculus and 2/3 units of statistics.

Item #	Title	Units
MA 1021	Calculus I	1/3
MA 1022	Calculus II	1/3
MA 2611	Applied Statistics I	1/3
MA 2612	Applied Statistics II	1/3

Computer Science (1/3 unit)

A minimum of 1/3 unit of Computer Science focused on programming. CS 1004, CS 1101, or CS 1102 is recommended. (CS 2022 and CS 3043 are not accepted.)

Item #	Title	Units
CS 1004	Introduction to Programming for Non-Majors	1/3
CS 1101	Introduction to Program Design	1/3
CS 1102	Accelerated Introduction to Program Design	1/3

Basic Science (2/3 unit)

Any course with prefix: BB, CH, GE, PH

Social Sciences (2/3 units)

ECON 1110 or ECON 1120 or ECON 2910/ETR 2910 and

ID 2050 or one from DEV, ECON, ENV, GOV, PSY, SD, SOC, SS, STS

Item #	Title	Units
	ECON 1110 or ECON 1120 or ECON 2910/ETR 2910	1/3
	ID 2050 or one from DEV, ECON, ENV, GOV, PSY, SD, SOC, SS, STS	1/3

Management Engineering Core Curriculum

Financial Courses (3/3 unit)*

ACC 2060: Financial Statements for Decision Making; Select one course from: FIN 1250 Personal Finance, FIN 2070 Fundamentals of Finance, FIN 3300 Finance & Technology (FinTech); OIE 2850 Engineering Economics.

*Two courses at 3,000 level or above required across Financial and Managerial courses.

Item #	Title	Units
ACC 2060	Financial Statements for Decision Making	1/3
	FIN 1250 or FIN 2070 or FIN 3300	
OIE 2850	Engineering Economics	1/3

Managerial Courses (3/3 unit)*

Select one organizational behavior course (Recommended OBC 1010 Leadership Practice); Select one marketing course (Recommended MKT 4030 Achieving Strategic Effectiveness); Select one course from BUS 2020 The Legal Environment of Business Decisions, MIS 3010 Creating Value through Innovation, any course with an ETR, MKT, or OBC prefix.

*Two courses at 3,000 level or above required across Financial and Managerial courses.

Item #	Title	Units
OBC 1010	Leadership Practice	1/3
MKT 4030	Achieving Strategic Effectiveness	1/3
	BUS 2020 or MIS 3010, ETR, MKT, OBC course	1/3

Technical Courses (3/3 unit)

OIE 3020 Achieving Effective Operations; Select two courses from the following: AE, BB, BME, CE (except 3022), CH, CHE, CS (except 3043), DS, ECE, ES (except 1000), GE, OIE, MA, ME, PH, RBE (except 3100).

Item #	Title	Units
OIE 3020	Achieving Effective Operations	1/3
	Select two courses from the following: AE, BB, BME, CE (except 3022), CH, CHE, CS (except 3043), DS, ECE, ES (except 1000), GE, OIE, MA, ME, PH, RBE (except 3100)	2/3

Analytics Courses (3/3 unit)

OIE 3420 Quality Planning Design and Control; Select one course from: MIS 3720 Business Data Management, MIS 3787 Business Applications of Machine Learning, MIS 4084 Business Intelligence; Select one course from: BUS 2080 Data Analysis for Decision Making or OIE 2081 Introduction to Prescriptive Analytics, OIE 3460 Simulation Modeling and Analysis, OIE 3510 Stochastic Models, OIE 4430 Advanced Prescriptive Analytics: From Data to Impact.

Item #	Title	Units
OIE 3420	Quality Planning, Design and Control	1/3
	MIS 3720 or MIS 3787 or MIS 4084	1/3
	BUS 2080, OIE 2081, OIE 3460, OIE 3510, OIE 4430	1/3

Technical or Analytics Course (1/3 unit)

Select one additional course from remaining Technical or Analytics Courses.

Management Engineering Concentration Courses (6/3 Units)

Students selecting the Management Engineering Major must complete six courses from one of the concentrations as specified in the summary table for concentrations. Students may also work with their faculty advisor to create a custom MGE Program. Such custom programs must be approved by the advisor and the Business School's Undergraduate Policy and Curriculum Committee.

Manufacturing Engineering:

ETR 1100 or MKT 3640 and five from the list below

Item #	Title	Units
	ETR 1100 or MKT 3640	
BME 4814/ME 4814	Biomaterials	1/3
ES 2001	Introduction to Materials Science	1/3
ME 1800	Manufacturing Science, Prototyping, and Computer-Controlled Machining	1/3
ME 2820	Materials Processing	1/3
ME 3320	Design of Machine Elements	1/3
ME 3820	Computer-Aided Manufacturing	1/3
ME 4813	Ceramics and Glasses for Engineering Applications	1/3
ME 4821	Plastics	1/3
ME 4875/MTE 575	Introduction to Nanomaterials and Nanotechnology	1/3
RBE 4815	Industrial Robotics	1/3

MGE MQP (3/3 Units)

The MQP must have a focus in the concentration area with an MQP advisor from the Business School.

Free Electives (4/3 Units)

Program Chart and/or Course Flow Chart

MANAGEMENT ENGINEERING
OVERVIEW OF DEGREE REQUIREMENTS

UNIVERSITY REQUIREMENTS
HUMANITIES AND ARTS (6/3 Units): 6 courses including Inquiry Seminar/Practicum
SOCIAL SCIENCE (2/3 Units): ECON 1110 or ECON 1120 or ECON 2910 One from DEV, ECON, ENV, GOV, PSY, SD, SOC, SS, STS or ID 2050
PHYSICAL EDUCATION (1/3 Units)
INTERACTIVE QUALIFYING PROJECT (3/3 Unit)-3rd Year

MATHEMATICS AND SCIENCE REQUIREMENTS
BASIC SCIENCE (2/3 Units) BB, CH, GE, PH
MATHEMATICS (4/3 Units) Calculus - MA 1021; MA 1022; Statistics - MA 2611; MA 2612
COMPUTER SCIENCE (1/3 Units): CS 1004 (recommended) or CS 1101 or CS 1102

CORE MANGEMENT ENGINEERING CURRICULUM (6/3 Units) **3 from Financial Courses and 3 Managerial courses at least 2 courses are 3000 or higher level.**	
Financial Courses	**Managerial Courses**
1. ACC 2060 2. Any finance course FIN 1250, FIN 2070, FIN 3300 3. OIE 2850	1. Select any organizational behavior course (recommended OBC 1010) 2. Select any marketing course (recommended MKT 4030) 3. Select any course from: BUS 2020, MIS 3010, any course with an ETR, ETR or OBC prefix.

TECHNICAL AND ANALYTICS COURSES (6/3 Units) **Minimum 3 courses from each type**	
Technical Courses	**Analytics Courses**
1. OIE 3020 2. Select two courses from the following: AE, BB, BME, CE (except 3022), CH, CHE, CS (except 3043), DS, ECE, ES (except 1000), GE, OIE, MA, ME, PH, RBE (except 3100).	1. OIE 3420 2. Select one course from: MIS 3720, MIS 3787, MIS 4084 3. Select one course from: BUS 2080 or OIE 2081, OIE 3460, OIE 3510, OIE 4430.

TECHNICAL or ANALYTICS COURSES (1/3 Units) **Select one from the remaining Technical or Analytics Elective courses.**

MAJOR QUALIFYING PROJECT (3/3 Units) **The MQP must have a focus in the concentration area with an MQP advisor from the Business School.**

FREE ELECTIVES (4/3 Units)

SUMMARY TABLE

MANAGEMENT ENGINEERING CONCENTRATION COURSES 2023-24 (6/3 Units)

Select 5 courses from concentration + 1 from ETR 1100 or MKT 3640

Biomedical Engineering	Civil Engineering	Electrical and Computer Engineering	Industrial Engineering
1. ETR 1100 or MKT 3640 2. Select five courses from: BME 1001, BME 2001, BME 2210, BME 2211, BME 2502, BME 3300, BME 3111, BME 3610, BB 3101, BB 3102	1. ETR 1100 or MKT 3640 2. Select five courses from: AREN 2023, CE 1030, CE 2000, CE 2001, CE 2020, CE 3020, CE 3022, CE 3025, CE 3030, CE 3031, CE 3041, ES 3004	1. ETR 1100 or MKT 3640 2. Select five courses from: ECE 2010, ECE 2019, ECE 2029, ECE 2049, ECE 2112, ECE 2311, ECE 2312, ECE 2799	1. ETR 1100 or MKT 3640 2. Select five courses from: MIS 3720, OIE 2081, OIE 2600, OIE 3405, OIE 3410, OIE 3460, OIE 3510, OIE 4410, OIE 4430
Information Technology	**Manufacturing Engineering**	**Mechanical Engineering**	**Custom**
1. ETR 1100 or MKT 3640 2. MIS 3720 3. MIS 4720 4. Select three courses from: MIS 3787, MIS 4084, MIS 4741, CS 2119, CS 2102/2103, CS 2301/2303, CS 3041, DS 1010	1. ETR 1100 or MKT 3640 2. Select five courses from: ES 2001, ME 1800, ME 2820, ME 3320, ME 3820, ME 4718, ME 4810, ME 4813, ME 4814, ME 4815, ME 4821, ME 4875	1. ETR 1100 or MKT 3640 2. Select five courses from: ES 2001, ES 2501, ES 2502, ES 2503, ES 3001, ES 3003, ES 3004, ME 1800, ME 2300, ME 2820, ME 3820, ME 3901 or 3902, ME 4320, ME 4429, ME 4430	1. ETR 1100 or MKT 3640 2. Students with their advisor select a name for the custom concentration and five relevant STEM courses (typically selected from courses that satisfy the technical or analytical electives of the MGE degree). All custom concentrations must be approved by the Undergraduate Committee (UPCC) of the Business School.

Effective for AY 2023-24

Management Engineering Major with Concentration in Mechanical Engineering

Degree Type

Concentration

Educational Objectives

Objectives of the Management Engineering Major are:

- To prepare students for management challenges in key areas that increasingly require proficiency in the technical aspects of business such as production and service operations.
- To provide the knowledge and skills necessary to succeed professionally, including literacy in a technical field, a broad understanding of management issues, written communication, oral presentation, decision-making, and leadership skills required to create new and improved products, processes and control systems.
- To develop student abilities necessary for continued career growth including:
    - the ability to integrate theory and practice and to apply knowledge of technical issues with the foundations of management
    - the ability to integrate technology and change into existing organizations
    - the ability to think critically and analytically, to define and solve business problems, work in teams, and think globally; and
    - the ability to learn new skills in response to changing professional requirements.

Program Distribution Requirements for the Management Engineering Major

Mathematics and Science

Mathematics (4/3 units)

Mathematics must include 2/3 units of calculus and 2/3 units of statistics.

Item #	Title	Units
MA 1021	Calculus I	1/3
MA 1022	Calculus II	1/3
MA 2611	Applied Statistics I	1/3
MA 2612	Applied Statistics II	1/3

Computer Science (1/3 unit)

A minimum of 1/3 unit of Computer Science focused on programming. CS 1004, CS 1101, or CS 1102 is recommended. (CS 2022 and CS 3043 are not accepted.)

Item #	Title	Units
CS 1004	Introduction to Programming for Non-Majors	1/3
CS 1101	Introduction to Program Design	1/3
CS 1102	Accelerated Introduction to Program Design	1/3

Basic Science (2/3 unit)

Any course with prefix: BB, CH, GE, PH

Social Sciences (2/3 units)

ECON 1110 or ECON 1120 or ECON 2910/ETR 2910 and

ID 2050 or one from DEV, ECON, ENV, GOV, PSY, SD, SOC, SS, STS

Item #	Title	Units
	ECON 1110 or ECON 1120 or ECON 2910/ETR 2910	1/3
	ID 2050 or one from DEV, ECON, ENV, GOV, PSY, SD, SOC, SS, STS	1/3

Management Engineering Core Curriculum

Financial Courses (3/3 unit)*

ACC 2060: Financial Statements for Decision Making; Select one course from: FIN 1250 Personal Finance, FIN 2070 Fundamentals of Finance, FIN 3300 Finance & Technology (FinTech); OIE 2850 Engineering Economics.

*Two courses at 3,000 level or above required across Financial and Managerial courses.

Item #	Title	Units
ACC 2060	Financial Statements for Decision Making	1/3
	FIN 1250 or FIN 2070 or FIN 3300	
OIE 2850	Engineering Economics	1/3

Managerial Courses (3/3 unit)*

Select one organizational behavior course (Recommended OBC 1010 Leadership Practice); Select one marketing course (Recommended MKT 4030 Achieving Strategic Effectiveness); Select one course from BUS 2020 The Legal Environment of Business Decisions, MIS 3010 Creating Value through Innovation, any course with an ETR, MKT, or OBC prefix.

*Two courses at 3,000 level or above required across Financial and Managerial courses.

Item #	Title	Units
OBC 1010	Leadership Practice	1/3
MKT 4030	Achieving Strategic Effectiveness	1/3
	BUS 2020 or MIS 3010, ETR, MKT, OBC course	1/3

Technical Courses (3/3 unit)

OIE 3020 Achieving Effective Operations; Select two courses from the following: AE, BB, BME, CE (except 3022), CH, CHE, CS (except 3043), DS, ECE, ES (except 1000), GE, OIE, MA, ME, PH, RBE (except 3100).

Item #	Title	Units
OIE 3020	Achieving Effective Operations	1/3
	Select two courses from the following: AE, BB, BME, CE (except 3022), CH, CHE, CS (except 3043), DS, ECE, ES (except 1000), GE, OIE, MA, ME, PH, RBE (except 3100)	2/3

Analytics Courses (3/3 unit)

OIE 3420 Quality Planning Design and Control; Select one course from: MIS 3720 Business Data Management, MIS 3787 Business Applications of Machine Learning, MIS 4084 Business Intelligence; Select one course from: BUS 2080 Data Analysis for Decision Making or OIE 2081 Introduction to Prescriptive Analytics, OIE 3460 Simulation Modeling and Analysis, OIE 3510 Stochastic Models, OIE 4430 Advanced Prescriptive Analytics: From Data to Impact.

Item #	Title	Units
OIE 3420	Quality Planning, Design and Control	1/3
	MIS 3720 or MIS 3787 or MIS 4084	1/3
	BUS 2080, OIE 2081, OIE 3460, OIE 3510, OIE 4430	1/3

Technical or Analytics Course (1/3 unit)

Select one additional course from remaining Technical or Analytics Courses.

Management Engineering Concentration Courses (6/3 Units)

Students selecting the Management Engineering Major must complete six courses from one of the concentrations as specified in the summary table for concentrations. Students may also work with their faculty advisor to create a custom MGE Program. Such custom programs must be approved by the advisor and the Business School's Undergraduate Policy and Curriculum Committee.

Mechanical Engineering:

ETR 1100 or MKT 3640 and five from the list below

Item #	Title	Units
	ETR 1100 or MKT 3640	
ES 2001	Introduction to Materials Science	1/3
ES 2501	Introduction to Static Systems	1/3
ES 2502	Stress Analysis	1/3
ES 2503	Introduction to Dynamic Systems	1/3
ES 3001	Introduction to Thermodynamics	1/3
ES 3003	Heat Transfer	1/3
ES 3004	Fluid Mechanics	1/3
ME 1800	Manufacturing Science, Prototyping, and Computer-Controlled Machining	1/3
ME 2300	Introduction to Engineering Design	1/3
ME 2820	Materials Processing	1/3
ME 3820	Computer-Aided Manufacturing	1/3
ME 3901	Engineering Experimentation	1/3
ME 3902	Project-Based Engineering Experimentation	1/3
ME 4320	Advanced Engineering Design	1/3
ME 4429	Thermofluid Application and Design	1/3
ME 4430	Integrated Thermomechanical Design and Analysis	1/3

MGE MQP (3/3 Units)

The MQP must have a focus in the concentration area with an MQP advisor from the Business School.

Free Electives (4/3 Units)

Program Chart and/or Course Flow Chart

MANAGEMENT ENGINEERING
OVERVIEW OF DEGREE REQUIREMENTS

UNIVERSITY REQUIREMENTS
HUMANITIES AND ARTS (6/3 Units): 6 courses including Inquiry Seminar/Practicum
SOCIAL SCIENCE (2/3 Units): ECON 1110 or ECON 1120 or ECON 2910 One from DEV, ECON, ENV, GOV, PSY, SD, SOC, SS, STS or ID 2050
PHYSICAL EDUCATION (1/3 Units)
INTERACTIVE QUALIFYING PROJECT (3/3 Unit)-3rd Year

MATHEMATICS AND SCIENCE REQUIREMENTS
BASIC SCIENCE (2/3 Units) BB, CH, GE, PH
MATHEMATICS (4/3 Units) Calculus - MA 1021; MA 1022; Statistics - MA 2611; MA 2612
COMPUTER SCIENCE (1/3 Units): CS 1004 (recommended) or CS 1101 or CS 1102

CORE MANGEMENT ENGINEERING CURRICULUM (6/3 Units) 3 from Financial Courses and 3 Managerial courses at least 2 courses are 3000 or higher level.	
Financial Courses	**Managerial Courses**
1. ACC 2060 2. Any finance course FIN 1250, FIN 2070, FIN 3300 3. OIE 2850	1. Select any organizational behavior course (recommended OBC 1010) 2. Select any marketing course (recommended MKT 4030) 3. Select any course from: BUS 2020, MIS 3010, any course with an ETR, ETR or OBC prefix.

TECHNICAL AND ANALYTICS COURSES (6/3 Units) Minimum 3 courses from each type	
Technical Courses	**Analytics Courses**
1. OIE 3020 2. Select two courses from the following: AE, BB, BME, CE (except 3022), CH, CHE, CS (except 3043), DS, ECE, ES (except 1000), GE, OIE, MA, ME, PH, RBE (except 3100).	1. OIE 3420 2. Select one course from: MIS 3720, MIS 3787, MIS 4084 3. Select one course from: BUS 2080 or OIE 2081, OIE 3460, OIE 3510, OIE 4430.

TECHNICAL or ANALYTICS COURSES (1/3 Units) Select one from the remaining Technical or Analytics Elective courses.

MAJOR QUALIFYING PROJECT (3/3 Units) The MQP must have a focus in the concentration area with an MQP advisor from the Business School.

FREE ELECTIVES (4/3 Units)

SUMMARY TABLE

MANAGEMENT ENGINEERING CONCENTRATION COURSES 2023-24 (6/3 Units)

Select 5 courses from concentration + 1 from ETR 1100 or MKT 3640

Biomedical Engineering	Civil Engineering	Electrical and Computer Engineering	Industrial Engineering
1. ETR 1100 or MKT 3640 2. Select five courses from: BME 1001, BME 2001, BME 2210, BME 2211, BME 2502, BME 3300, BME 3111, BME 3610, BB 3101, BB 3102	1. ETR 1100 or MKT 3640 2. Select five courses from: AREN 2023, CE 1030, CE 2000, CE 2001, CE 2020, CE 3020, CE 3022, CE 3025, CE 3030, CE 3031, CE 3041, ES 3004	1. ETR 1100 or MKT 3640 2. Select five courses from: ECE 2010, ECE 2019, ECE 2029, ECE 2049, ECE 2112, ECE 2311, ECE 2312, ECE 2799	1. ETR 1100 or MKT 3640 2. Select five courses from: MIS 3720, OIE 2081, OIE 2600, OIE 3405, OIE 3410, OIE 3460, OIE 3510, OIE 4410, OIE 4430
Information Technology	**Manufacturing Engineering**	**Mechanical Engineering**	**Custom**
1. ETR 1100 or MKT 3640 2. MIS 3720 3. MIS 4720 4. Select three courses from: MIS 3787, MIS 4084, MIS 4741, CS 2119, CS 2102/2103, CS 2301/2303, CS 3041, DS 1010	1. ETR 1100 or MKT 3640 2. Select five courses from: ES 2001, ME 1800, ME 2820, ME 3320, ME 3820, ME 4718, ME 4810, ME 4813, ME 4814, ME 4815, ME 4821, ME 4875	1. ETR 1100 or MKT 3640 2. Select five courses from: ES 2001, ES 2501, ES 2502, ES 2503, ES 3001, ES 3003, ES 3004, ME 1800, ME 2300, ME 2820, ME 3820, ME 3901 or 3902, ME 4320, ME 4429, ME 4430	1. ETR 1100 or MKT 3640 2. Students with their advisor select a name for the custom concentration and five relevant STEM courses (typically selected from courses that satisfy the technical or analytical electives of the MGE degree). All custom concentrations must be approved by the Undergraduate Committee (UPCC) of the Business School.

Effective for AY 2023-24

Management Engineering Major with Custom Concentration

Degree Type

Concentration

Educational Objectives

Objectives of the Management Engineering Major are:

- To prepare students for management challenges in key areas that increasingly require proficiency in the technical aspects of business such as production and service operations.
- To provide the knowledge and skills necessary to succeed professionally, including literacy in a technical field, a broad understanding of management issues, written communication, oral presentation, decision-making, and leadership skills required to create new and improved products, processes and control systems.
- To develop student abilities necessary for continued career growth including:
  - the ability to integrate theory and practice and to apply knowledge of technical issues with the foundations of management
  - the ability to integrate technology and change into existing organizations
  - the ability to think critically and analytically, to define and solve business problems, work in teams, and think globally; and
  - the ability to learn new skills in response to changing professional requirements.

Program Distribution Requirements for the Management Engineering Major

Mathematics and Science

Mathematics (4/3 units)

Mathematics must include 2/3 units of calculus and 2/3 units of statistics.

Item #	Title	Units
MA 1021	Calculus I	1/3
MA 1022	Calculus II	1/3
MA 2611	Applied Statistics I	1/3
MA 2612	Applied Statistics II	1/3

Computer Science (1/3 unit)

A minimum of 1/3 unit of Computer Science focused on programming. CS 1004, CS 1101, or CS 1102 is recommended. (CS 2022 and CS 3043 are not accepted.)

Item #	Title	Units
CS 1004	Introduction to Programming for Non-Majors	1/3
CS 1101	Introduction to Program Design	1/3
CS 1102	Accelerated Introduction to Program Design	1/3

Basic Science (2/3 unit)

Any course with prefix: BB, CH, GE, PH

Social Sciences (2/3 units)

ECON 1110 or ECON 1120 or ECON 2910/ETR 2910 and

ID 2050 or one from DEV, ECON, ENV, GOV, PSY, SD, SOC, SS, STS

Item #	Title	Units
	ECON 1110 or ECON 1120 or ECON 2910/ETR 2910	1/3
	ID 2050 or one from DEV, ECON, ENV, GOV, PSY, SD, SOC, SS, STS	1/3

Management Engineering Core Curriculum

Financial Courses (3/3 unit)*

ACC 2060: Financial Statements for Decision Making; Select one course from: FIN 1250 Personal Finance, FIN 2070 Fundamentals of Finance, FIN 3300 Finance & Technology (FinTech); OIE 2850 Engineering Economics.

*Two courses at 3,000 level or above required across Financial and Managerial courses.

Item #	Title	Units
ACC 2060	Financial Statements for Decision Making	1/3
	FIN 1250 or FIN 2070 or FIN 3300	
OIE 2850	Engineering Economics	1/3

Managerial Courses (3/3 unit)*

Select one organizational behavior course (Recommended OBC 1010 Leadership Practice); Select one marketing course (Recommended MKT 4030 Achieving Strategic Effectiveness); Select one course from BUS 2020 The Legal Environment of Business Decisions, MIS 3010 Creating Value through Innovation, any course with an ETR, MKT, or OBC prefix.

*Two courses at 3,000 level or above required across Financial and Managerial courses.

Item #	Title	Units
OBC 1010	Leadership Practice	1/3
MKT 4030	Achieving Strategic Effectiveness	1/3
	BUS 2020 or MIS 3010, ETR, MKT, OBC course	1/3

Technical Courses (3/3 unit)

OIE 3020 Achieving Effective Operations; Select two courses from the following: AE, BB, BME, CE (except 3022), CH, CHE, CS (except 3043), DS, ECE, ES (except 1000), GE, OIE, MA, ME, PH, RBE (except 3100).

Item #	Title	Units
OIE 3020	Achieving Effective Operations	1/3
	Select two courses from the following: AE, BB, BME, CE (except 3022), CH, CHE, CS (except 3043), DS, ECE, ES (except 1000), GE, OIE, MA, ME, PH, RBE (except 3100)	2/3

Analytics Courses (3/3 unit)

OIE 3420 Quality Planning Design and Control; Select one course from: MIS 3720 Business Data Management, MIS 3787 Business Applications of Machine Learning, MIS 4084 Business Intelligence; Select one course from: BUS 2080 Data Analysis for Decision Making or OIE 2081 Introduction to Prescriptive Analytics, OIE 3460 Simulation Modeling and Analysis, OIE 3510 Stochastic Models, OIE 4430 Advanced Prescriptive Analytics: From Data to Impact.

Item #	Title	Units
OIE 3420	Quality Planning, Design and Control	1/3
	MIS 3720 or MIS 3787 or MIS 4084	1/3
	BUS 2080, OIE 2081, OIE 3460, OIE 3510, OIE 4430	1/3

Technical or Analytics Course (1/3 unit)

Select one additional course from remaining Technical or Analytics Courses.

Management Engineering Concentration Courses (6/3 Units)

Students selecting the Management Engineering Major must complete six courses from one of the concentrations as specified in the summary table for concentrations. Students may also work with their faculty advisor to create a custom MGE Program. Such custom programs must be approved by the advisor and the Business School's Undergraduate Policy and Curriculum Committee.

MGE MQP (3/3 Units)

The MQP must have a focus in the concentration area with an MQP advisor from the Business School.

Free Electives (4/3 Units)

Program Chart and/or Course Flow Chart

MANAGEMENT ENGINEERING
OVERVIEW OF DEGREE REQUIREMENTS

UNIVERSITY REQUIREMENTS
HUMANITIES AND ARTS (6/3 Units): 6 courses including Inquiry Seminar/Practicum
SOCIAL SCIENCE (2/3 Units): ECON 1110 or ECON 1120 or ECON 2910 One from DEV, ECON, ENV, GOV, PSY, SD, SOC, SS, STS or ID 2050
PHYSICAL EDUCATION (1/3 Units)
INTERACTIVE QUALIFYING PROJECT (3/3 Unit)-3rd Year

MATHEMATICS AND SCIENCE REQUIREMENTS
BASIC SCIENCE (2/3 Units) BB, CH, GE, PH
MATHEMATICS (4/3 Units) Calculus - MA 1021; MA 1022; Statistics - MA 2611; MA 2612
COMPUTER SCIENCE (1/3 Units): CS 1004 (recommended) or CS 1101 or CS 1102

CORE MANGEMENT ENGINEERING CURRICULUM (6/3 Units) 3 from Financial Courses and 3 Managerial courses at least 2 courses are 3000 or higher level.	
Financial Courses	**Managerial Courses**
1. ACC 2060 2. Any finance course FIN 1250, FIN 2070, FIN 3300 3. OIE 2850	1. Select any organizational behavior course (recommended OBC 1010) 2. Select any marketing course (recommended MKT 4030) 3. Select any course from: BUS 2020, MIS 3010, any course with an ETR, ETR or OBC prefix.

TECHNICAL AND ANALYTICS COURSES (6/3 Units) Minimum 3 courses from each type	
Technical Courses	**Analytics Courses**
1. OIE 3020 2. Select two courses from the following: AE, BB, BME, CE (except 3022), CH, CHE, CS (except 3043), DS, ECE, ES (except 1000), GE, OIE, MA, ME, PH, RBE (except 3100).	1. OIE 3420 2. Select one course from: MIS 3720, MIS 3787, MIS 4084 3. Select one course from: BUS 2080 or OIE 2081, OIE 3460, OIE 3510, OIE 4430.

TECHNICAL or ANALYTICS COURSES (1/3 Units) Select one from the remaining Technical or Analytics Elective courses.

MAJOR QUALIFYING PROJECT (3/3 Units) The MQP must have a focus in the concentration area with an MQP advisor from the Business School.

FREE ELECTIVES (4/3 Units)

SUMMARY TABLE

MANAGEMENT ENGINEERING CONCENTRATION COURSES 2023-24 (6/3 Units)

Select 5 courses from concentration + 1 from ETR 1100 or MKT 3640

Biomedical Engineering	Civil Engineering	Electrical and Computer Engineering	Industrial Engineering
1. ETR 1100 or MKT 3640 2. Select five courses from: BME 1001, BME 2001, BME 2210, BME 2211, BME 2502, BME 3300, BME 3111, BME 3610, BB 3101, BB 3102	1. ETR 1100 or MKT 3640 2. Select five courses from: AREN 2023, CE 1030, CE 2000, CE 2001, CE 2020, CE 3020, CE 3022, CE 3025, CE 3030, CE 3031, CE 3041, ES 3004	1. ETR 1100 or MKT 3640 2. Select five courses from: ECE 2010, ECE 2019, ECE 2029, ECE 2049, ECE 2112, ECE 2311, ECE 2312, ECE 2799	1. ETR 1100 or MKT 3640 2. Select five courses from: MIS 3720, OIE 2081, OIE 2600, OIE 3405, OIE 3410, OIE 3460, OIE 3510, OIE 4410, OIE 4430
Information Technology	**Manufacturing Engineering**	**Mechanical Engineering**	**Custom**
1. ETR 1100 or MKT 3640 2. MIS 3720 3. MIS 4720 4. Select three courses from: MIS 3787, MIS 4084, MIS 4741, CS 2119, CS 2102/2103, CS 2301/2303, CS 3041, DS 1010	1. ETR 1100 or MKT 3640 2. Select five courses from: ES 2001, ME 1800, ME 2820, ME 3320, ME 3820, ME 4718, ME 4810, ME 4813, ME 4814, ME 4815, ME 4821, ME 4875	1. ETR 1100 or MKT 3640 2. Select five courses from: ES 2001, ES 2501, ES 2502, ES 2503, ES 3001, ES 3003, ES 3004, ME 1800, ME 2300, ME 2820, ME 3820, ME 3901 or 3902, ME 4320, ME 4429, ME 4430	1. ETR 1100 or MKT 3640 2. Students with their advisor select a name for the custom concentration and five relevant STEM courses (typically selected from courses that satisfy the technical or analytical electives of the MGE degree). All custom concentrations must be approved by the Undergraduate Committee (UPCC) of the Business School.

Effective for AY 2023-24

Mechanical and Materials Engineering

R. Hyers, HEAD

PROFESSORS: C. A. Brown, C. Demetry, C. Furlong, S. Guceri, Z. Hou, D. Lados, J.Liang, M. M. Makhlouf, B. Mishra, B. J. Savilonis, W. Soboyejo, J. M. Sullivan, Jr., V. Vantsevich, Y. Wang, J. Yagoobi

PROFESSORS OF PRACTICE: L. Moradi

ASSOCIATE PROFESSORS: M. Fofana, Y. Liu, Z. Mao, A. Powell, P. Rao, Y. Zhong

ASSISTANT PROFESSORS: L. Cheng, D. Cote, A. Gnanaskandan, Y. Zheng

ASSOCIATE TEACHING PROFESSORS: F. Levey, M. Mortazavi, P. Radhakrishnan, S. Wodin-Schwartz

ASSISTANT TEACHING PROFESSORS: M. Bhatia, A. Ebadi, A. Sabuncu

ADJUNCT TEACHING PROFESSORS: E. Cobb

INSTRUCTORS: J. Stabile

ASSOCIATED FACULTY : N. Bertozzi (RBE), K. Billiar (BME), K. Chen (STEM), N. Dembsey (FPE), S. Ji (BME), S. Johnson (BUS), G. Lewin (RBE), R. Ludwig (ECE), W. Michalson (RBE), S. Mensah (BME), K. Notarianni (FPE), N. Rahbar (CEE), A. Rangwala (FPE), A. Simeoni (FPE), D. Strong (BUS), B. Tilley (MA), M. Timko (CE) W. Towner (BUS), K. Troy (BME), J. Urban (FPE), J. Xiao (RBE)

EMERITUS PROFESSORS: H. Ault, R. Biederman, J. M. Boyd, A.H. Hoffman, J. A. Mayer, Jr., R. L. Norton, D. Planchard, R. J. Pryputniewicz

Mission Statement

The Mechanical Engineering program at WPI aims to graduate students who have the broad expertise required to confront real world technological issues that arise in our society. Students in the program are educated to apply scientific principles and engineering methods to analyze and design systems, processes, and products that, when engineered properly, improve the quality of our lives. The Mechanical Engineering program is consistent with the WPI philosophy of education, in which each student develops the tools required for self-learning, and the sensibility to consider the impact of technology on society in the decisions they will make as engineering professionals.

Program Educational Objectives

The Mechanical Engineering Program seeks to have alumni who:

- are successful professionals because of their mastery of the fundamental engineering sciences, and mechanical engineering and their understanding of design processes.
- are leaders in business and society due to a broad preparation in technology, communication, teamwork, globalization, ethics, business acumen and entrepreneurship.
- will use their understanding of the impact of technology on the safety, health and welfare of the public for the betterment of humankind.

Student Outcomes

Graduating students should demonstrate that they attained the following:

- an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

- an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
- an ability to communicate effectively with a range of audiences
- an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
- an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
- an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
- an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

The second digit in mechanical engineering course numbers is coded as follows:

0 — General mechanical engineering
1 —
2 —
3 — Design
4 — Thermal—fluids
5 — Engineering mechanics
6 — Fluid mechanics—hydraulics
7 — Aerospace
8 — Materials
9 — Engineering experimentation

Mechanical Engineering Major

Degree Type
Bachelor of Science

Program Distribution Requirements for the Mechanical Engineering Major

The normal period of residency at WPI is 16 terms. In addition to WPI requirements applicable to all students (see page 7), students wishing to receive the ABET-accredited degree designated “Mechanical Engineering” must satisfy certain additional distribution requirements. These requirements apply to 10 units of study in the areas of mathematics, basic science, and engineering science and design as follows:

Mathematics and Basic Science (Minimum 11/3 Units)

Mathematics (Minimum 6/3 Units)

Differential & Integral Calculus, Ordinary Differential Equations, and Linear Algebra.

Item #	Title	Units
MA 1021	Calculus I	1/3
MA 1022	Calculus II	1/3
MA 1023	Calculus III	1/3
MA 1024	Calculus IV	1/3
MA 2051	Ordinary Differential Equations	1/3
MA 2071	Matrices and Linear Algebra I	1/3

Chemistry (Minimum 1/3 Units) and Physics (Minimum 2/3 Units) *OR* Physics (Minimum 1/3 Units) and Chemistry (Minimum 2/3 Units)

One Chemistry and two Physics, OR one Physics and two Chemistry courses.

Item #	Title	Units
CH 1010	Chemical Properties, Bonding, and Forces	1/3
CH 1020	Chemical Reactions	1/3
PH 1110	General Physics—Mechanics	1/3
PH 1120	General Physics—Electricity and Magnetism	1/3

Additional Mathematics and/or Basic Science (Minimum 2/3 Units)

Student-selected courses from the general category of Mathematics and/or Basic Science

Mechanical Engineering Science and Design (Minimum 19/3 Units)

Programming (Minimum 1/3 Unit)

Must include 1/3 unit in programming.

Programming Courses

Item #	Title	Units
BME 1004	Introduction to Programming in Matlab	1/3
CS 1004	Introduction to Programming for Non-Majors	1/3
CS 1101	Introduction to Program Design	1/3
ME 2312	Introduction to Computational Solutions for Engineering Problems	1/3
ME 4512	Introduction to the Finite Element Method	1/3

Electrical Engineering (Minimum 1/3 Unit)

Must include 1/3 unit in electrical engineering (ECE 2010 or any ECE course other than ECE 1799).

Electrical Engineering Courses

Item #	Title	Units
ECE 2010	Introduction to Electrical and Computer Engineering	1/3
BME 4011/ECE 4011	Biomedical Signal Analysis	1/3
BME 4023/ECE 4023	Biomedical Instrumentation Design	1/3
CS 4801/ECE 4802	Introduction to Cryptography and Communication Security	1/3
ECE 2010	Introduction to Electrical and Computer Engineering	1/3
ECE 2019	Sensors, Circuits, and Systems	1/3
ECE 2029	Introduction to Digital Circuit Design	1/3
ECE 2049	Embedded Computing in Engineering Design	1/3
ECE 2112	Electromagnetic Fields	1/3
ECE 2201	Microelectronic Circuits I	1/3
ECE 2305	Introduction to Communications and Networks	1/3
ECE 2311	Continuous-Time Signal and System Analysis	1/3
ECE 2312	Discrete-Time Signal and System Analysis	1/3
ECE 2799	Electrical and Computer Engineering Design	1/3
ECE 3012	Introduction to Control Systems Engineering	1/3
ECE 3113	Introduction to RF Circuit Design	1/3
ECE 3204	Microelectronic Circuits II	1/3
ECE 3308	Introduction to Wireless Networks	1/3
ECE 3311	Principles of Communication Systems	1/3
ECE 3500	Electric Power and Renewable Energy Systems	1/3
ECE 3501	Electromechanical Energy Systems	1/3
ECE 3829	Advanced Digital System Design with FPGAs	1/3
ECE 3849	Real-Time Embedded Systems	1/3
ECE 4305	Software-Defined Radio Systems and Analysis	1/3
ECE 4503	Power Electronics And Power Management	1/3
ECE 4703	Real-Time Digital Signal Processing	1/3
ECE 4801	Computer Organization and Design	1/3
ECE 4902	Analog Integrated Circuit Design	1/3
ECE 4904	Semiconductor Devices	1/3

Materials Science (Minimum 1/3 Unit)

Must include 1/3 unit in materials science.

Materials Science Courses

Item #	Title	Units
ES 2001	Introduction to Materials Science	1/3

Mechanical Engineering Experimentation (Minimum 1/3 Unit)

Must include 1/3 unit in mechanical engineering experimentation.

Mechanical Engineering Experimentation Courses

Item #	Title	Units
ME 3901	Engineering Experimentation	1/3
ME 3902	Project-Based Engineering Experimentation	1/3

Mechanical Engineering Electives (Minimum 4/3 Unit)

Elective courses from engineering disciplines may be selected at the 2000 or higher level. They may also include ES and ME courses at the 1000 level.

Two Stems of Coherent Course and/or Project Offerings:

Mechanical Systems (Minimum 4/3 Units)

A minimum of 4/3 unit of work in mechanical systems that includes the topics of statics, stress analysis, and dynamics, plus 1/3 unit at or above the 4000 level that integrates mechanical design.

Mechanical Systems Courses

Item #	Title	Units
ES 2501	Introduction to Static Systems	1/3
ES 2502	Stress Analysis	1/3
ES 2503	Introduction to Dynamic Systems	1/3
ME 4320	Advanced Engineering Design	1/3
ME 4323	Fundamentals of Drivetrain Systems	1/3
ME 4324	Integrated Design of Mechanical Systems	1/3
RBE 4322/ME 4322	Modeling and Analysis of Mechatronic Systems	1/3

Thermofluid Systems (Minimum 4/3 Units)

Must include a minimum of 4/3 unit of work in thermofluid systems that includes the topics of thermodynamics, fluid mechanics and heat transfer, plus 1/3 unit at or above the 4000 level that integrates thermofluid design. ES 3001 may be replaced by CH 3510 or PH Thermodynamics. If CH or PH is used to cover thermodynamics, this course counts as a science; another engineering elective is then required.

Thermofluid Systems Courses

Item #	Title	Units
ES 3001	Introduction to Thermodynamics	1/3
ES 3003	Heat Transfer	1/3
ES 3004	Fluid Mechanics	1/3
ME 4422	Design and Optimization of Thermal Systems	1/3
ME 4429	Thermofluid Application and Design	1/3
PH 2101	Principles of Thermodynamics	1/3
CH 3510	Chemical Thermodynamics	1/3

Major Qualifying Project (Minimum 3/3 Unit)

Each Mechanical Engineering student must complete a Major Qualifying Project.

Enhanced Programs

Bachelor/Master’s Program in Mechanical Engineering

Outstanding students are encouraged to combine a master’s degree with their undergraduate WPI studies. Details are found in the WPI Graduate Program section of this catalog, and interested students should initiate discussions with their advisor early in their junior year.

Cooperative Education Program

The WPI Cooperative Education Program provides an opportunity to integrate “real-world” experience into an educational program.

Program Chart and/or Course Flow Chart

MECHANICAL ENGINEERING PROGRAM CHART

STUDENTS EARNING A B.S. DEGREE IN MECHANICAL ENGINEERING MUST COMPLETE 15 UNITS OF STUDY, DISTRIBUTED AS FOLLOWS:

4 UNITS OF NON-TECHNICAL ACTIVITIES

2 UNITS HUMANITIES AND ARTS	*See WPI Requirements*
1 UNIT INTERACTIVE QUALIFYING (IQP) PROJECT	*See WPI Requirements*
2/3 UNIT SOCIAL SCIENCE	*See WPI Requirements*
1/3 UNIT PHYSICAL EDUCATION	*See WPI Requirements*

1 UNIT FREE ELECTIVE

1 UNIT FREE ELECTIVE	*See Catalog*

3 2/3 UNITS OF MATHEMATICS (MA) AND BASIC SCIENCE (BB, CH, GE 2341, PH)

2 Units
Differential & Integral Calculus,
Ordinary Differential Equations,
and Linear Algebra

MATHEMATICS	
MA 1021	MA 1023
MA 1022	MA 1024
MA 2051	MA 2071

2/3 Units
Student Selected Courses from
the General Category of Mathematics
and/or Basic Science

3/3 Units
One Chemistry and Two Physics, OR
One Physics and Two Chemistry

SCIENCE	
CH 1010	CH 1020
PH 1110	PH 1120

6 1/3 UNITS OF MECHANICAL ENGINEERING

4/3 units required	4/3 units required	4/3 units required	1 unit required	4/3 units required
MECHANICAL SYSTEMS	**THERMAL SYSTEMS**	**OTHER COURSES**	**MAJOR QUALIFYING PROJECT (MQP)**	**ELECTIVES**
ES 2501 ES 2502 ES 2503 One of: ME 4320 ME 4322 ME 4323 ME 4324	ES 3001[2] ES 3004 ES 3003 One of: ME 4422 ME 4429	ES 2001 ECE 2010[3] (ME 3901 or ME3902) One Programming Course (ME 2312, ME 4512, BME 1004, CS 1101, or CS 1004)		Engineering (Note 1)

Note 1: Elective courses from engineering disciplines may be selected at the 2000 or higher level. They may also include ES and ME courses at the 1000 level.

Note 2: ES 3001 may be replaced by CH 3510 or PH Thermodynamics. If CH or PH is used to cover thermodynamics, this course counts as a science; another engineering elective is then required.

Note 3: ECE 2010 or any ECE course other than ECE 1799.

Manufacturing Engineering Minor

Degree Type

Minor

A minor in Manufacturing Engineering gives students from a variety of majors the opportunity to strengthen their academic preparation and attractiveness to industry, while better preparing them to solve many of the problems that will challenge them in their careers. Most engineers are involved directly or indirectly with manufacturing or manufacturing principles. Manufacturing expertise is essential to all industrialized, developing and even post industrialized societies. The objective of the minor in manufacturing will be to give the students a solid understanding of the principles of production, processing, manufacturability, and quality that can be applied to a wide variety of products, including non-traditional products, such as software, service and information.

Program Distribution Requirements for the Manufacturing Engineering Minor

The minor requires the completion of 2 units of work as follows:

Core Manufacturing Engineering Coursework (Minimum 4/3 Units)

Students must complete 3/3 unit of required coursework selected from the following list:

Core Manufacturing Engineering Courses

Item #	Title	Units
ES 3011	Control Engineering I	1/3
ME 1800	Manufacturing Science, Prototyping, and Computer-Controlled Machining	1/3
ME 2820	Materials Processing	1/3
ME 3820	Computer-Aided Manufacturing	1/3

Elective Manufacturing Engineering Coursework (Minimum 2/3 Units)

Students must complete 2/3 unit of electives selected from the following list of courses. Note: any of the courses above, in section one, can count if the other three are completed.

Elective Manufacturing Engineering Courses

Item #	Title	Units
CS 4032/MA 3257	Numerical Methods for Linear and Nonlinear Systems	1/3
CS 4341	Introduction to Artificial Intelligence	1/3
ES 3323	Advanced Computer Aided Design	1/3
ME 3310	Kinematics of Mechanisms	1/3
ME 4821	Plastics	1/3
MFE 510	Control and Monitoring of Manufacturing Processes	1/3
MFE 511	Application of Industrial Robotics	1/3
MFE 520	Axiomatic Design of Manufacturing Processes	1/3
MFE 530	Computer Integrated Manufacturing	1/3
MFE 540	Design for Manufacturability	1/3
OIE 3020	Achieving Effective Operations	1/3
OIE 3420	Quality Planning, Design and Control	1/3

Manufacturing Engineering Capstone Experience (Minimum 1/3 Units)

Students must complete 1/3 unit of capstone experience coursework from the list below:

Manufacturing Engineering Capstone Experience Courses

Item #	Title	Units
MFE 510	Control and Monitoring of Manufacturing Processes	1/3
MFE 511	Application of Industrial Robotics	1/3
MFE 520	Axiomatic Design of Manufacturing Processes	1/3
MFE 530	Computer Integrated Manufacturing	1/3
MFE 540	Design for Manufacturability	1/3
MFE 598	Independent Study Project	1/3
RBE 4815	Industrial Robotics	1/3

Materials Engineering Minor

Degree Type

Minor

Material properties, material processing issues, or material costs are the limiting factor in the design or performance of almost all systems around us. Engineers, scientists, and managers in all technological sectors often must make material selection decisions based on a variety of considerations, including properties, performance, environmental impact, and cost. A Minor in Materials, feasible within a 15 unit program of study, will benefit students who wish to enhance their disciplinary major with an additional degree designation in the area of materials.

Notes:

1. In accordance with the Institute-wide policy on Minors, academic activities used in satisfying the regular degree requirements may be double-counted toward meeting all but one unit of the Minor requirements (see page 11).
2. Physics ISU courses in Superconductors, Photonics, and Lasers may also be counted toward the Materials Minor. In addition, other new or experimental course offerings in the materials area may be approved by the Materials Minor Program Review Committee.
3. Examples: An ECE major designing an integrated circuit for their MQP might conduct a separate analysis of the materials issues related to heat management in the device as the capstone experience for the Minor in Materials; a ME major specifying a gear in a design MQP might conduct a separate analysis of the material processing, structure, and property issues affecting fatigue life of the gear.
4. In accordance with the Institute-wide policy on Minors, the Major Qualifying Project (MQP) cannot be counted toward activity for a Minor. Therefore, a ME, CHE, or any other major whose MQP is judged to be predominantly in the materials area by the Program Review Committee may not count an extra 1/3 unit augmentation of their MQP as their capstone experience in the Minor.
5. The following faculty serve as the Program Review Committee for the Minor in Materials and will serve as Minor Advisors: Professors Liang and Mishra.

Program Distribution Requirements for the Materials Minor

The minor requires the completion of 2 units of work as described below

Introduction to Material Science (Minimum 1/3 Unit)

Students must complete ES 2001 Introduction to Material Science.

Item #	Title	Units
ES 2001	Introduction to Materials Science	1/3

Materials Engineering Electives (Minimum 4/3 Units)

Students must complete 4/3 units from the list of electives below.

Materials Engineering Electives

Item #	Title	Units
BME 4814/ME 4814	Biomaterials	1/3
CE 3026	Materials of Construction	1/3
CH 2310	Organic Chemistry I	1/3
CH 2320	Organic Chemistry II	1/3
CH 2330	Organic Chemistry III	1/3
CH 3410	Structure, Bonding, and Reactivity in Inorganic Chemistry	1/3
CH 4330	Organic Synthesis	1/3
ECE 4904	Semiconductor Devices	1/3
ME 2820	Materials Processing	1/3
ME 4813	Ceramics and Glasses for Engineering Applications	1/3
ME 4821	Plastics	1/3
ME 4832	Corrosion and Corrosion Control	1/3
ME 4840	Physical Metallurgy	1/3
ME 4875/MTE 575	Introduction to Nanomaterials and Nanotechnology	1/3
PH 2510	Atomic Force Microscopy	1/3
PH 3502	Solid State Physics	1/3

Students who are able to design their undergraduate program of study such that they have sufficient preparation may also use the following graduate courses toward a Materials Minor: all MTE graduate courses; CHE 510 Dynamics of Particulate Systems, CHE 531 Fuel Cell Technology.

Materials Engineering Capstone Experience (Minimum 1/3 Units)

The capstone experience requirement for the Minor in Materials must be satisfied by an upper level course or ISU activity that integrates and synthesizes material processing, structure, and property relationships as they affect performance.

1. Courses that satisfy the capstone experience requirement currently include those in the list below. Other courses must be approved in advance by the Program Committee for the Minor in Materials.
2. Students may satisfy the capstone experience requirement by completing a 1/3 unit ISU that receives prior approval from the Program Committee for the Minor in Materials. The ISU may, for example, take the form of a laboratory experience or may augment the MQP or IQP, considering in depth the materials issues associated with the project topic (see Note d). An ISU related to the MQP must be distinct from the core 1 unit of the MQP and in most cases would be advised by a faculty member other than the MQP advisor.

Materials Engineering Capstone Experience Courses

Item #	Title	Units
BME 4814/ME 4814	Biomaterials	1/3
ME 4813	Ceramics and Glasses for Engineering Applications	1/3
ME 4821	Plastics	1/3

Notes:

a. In accordance with the Institute-wide policy on Minors, academic activities used in satisfying the regular degree requirement may be double-counted toward meeting all but one unit of the Minor requirements.
b. Physics ISU courses in Superconductors, Photonics, and Lasers may also be counted toward the Materials Minor. In addition, other new or experimental course offerings in the materials area may be approved by the Materials Minor Program Review Committee.
c. Examples: An ECE major designing an integrated circuit for the MQP might conduct a separate analysis of the materials issues related to heat management in the device as the capstone experience for the Minor in Materials; a ME major specifying a gear in a design MQP might conduct a separate analysis of the material processing, structure, and property issues affecting fatigue life of the gear.
d. In accordance with the Institute-wide policy on Minors, the Major Qualifying Project (MQP) cannot be counted toward activity for a Minor. Therefore, a ME, CHE, or any other major whose MQP is judged to be predominantly in the materials area by the Program Review Committe may not count an extra 1/3 unit augmentation of their MQP as their capstone experience in the Minor.
e. The following faculty serve as the Program Review Committee for the Minor in Materials and will serve as Minor Advisors: Richard Sisson (ME), Chrys Demetry (ME), Tahar El-Korchi (CEE)

Mechanical Engineering Minor

Degree Type
Minor

For students who are not ME majors and are interested in broadening their exposure to and understanding of Mechanical Engineering, the ME department offers a Minor.

Students seeking an ME Minor should complete an ME-Minor form, available online and at the ME office, and submit it to the ME office as early in the program of study as possible. The chair of the ME Undergraduate Curriculum Committee will be responsible for review and approval of all ME Minor requests.

WPI policy requires that no more than one unit of course work can be double counted toward other degree requirements.

Program Distribution Requirement Summary for the Mechanical Engineering Minor

The Minor in Mechanical Engineering consists of 2 units of work from the lists below:

Intermediate Mechanical Engineering Coursework (Minimum 4/3 Units)

Select at least 4/3 unit from the following:

Intermediate Mechanical Engineering Courses

Item #	Title	Units
ES 2001	Introduction to Materials Science	1/3
ES 2501	Introduction to Static Systems	1/3
ES 2502	Stress Analysis	1/3
ES 2503	Introduction to Dynamic Systems	1/3
ES 3001	Introduction to Thermodynamics	1/3
ES 3003	Heat Transfer	1/3
ES 3004	Fluid Mechanics	1/3
ES 3323	Advanced Computer Aided Design	1/3
ME 3901	Engineering Experimentation	1/3
ME 3902	Project-Based Engineering Experimentation	1/3

Introductory Mechanical Engineering Coursework (*Maximum* 1/3 Units)

Select no more than 1/3 unit from the following:

Introductory Mechanical Engineering Courses

Item #	Title	Units
ES 1020	Introduction to Engineering	1/3
ES 1310	Introduction to Computer Aided Design	1/3
ME 1800	Manufacturing Science, Prototyping, and Computer-Controlled Machining	1/3

Advanced Mechanical Engineering Coursework (Minimum 1/3 Units)

Must include at least 1/3 unit of the following:

Advanced Mechanical Engineering Courses

Item #	Title	Units
ME 3310	Kinematics of Mechanisms	1/3
ME 3320	Design of Machine Elements	1/3
ME 4320	Advanced Engineering Design	1/3
ME 4323	Fundamentals of Drivetrain Systems	1/3
ME 4324	Integrated Design of Mechanical Systems	1/3
ME 4422	Design and Optimization of Thermal Systems	1/3
ME 4424	Radiation Heat Transfer Application and Design	1/3
ME 4429	Thermofluid Application and Design	1/3
ME 4505	Advanced Dynamics	1/3
ME 4506	Mechanical Vibrations	1/3
RBE 4322/ME 4322	Modeling and Analysis of Mechatronic Systems	1/3

Mechanical Engineering Major with Biomechanical Concentration

Degree Type
Concentration

Students blend biology and biotechnology coursework with continuum mechanics, biomechanics, biofluids, and biomedical materials to support their individual interest. MQPs are usually developed jointly with off-campus medical facilities, including the University of Massachusetts Medical Center.

Typically MQP topics include: soft tissue mechanics, flow in constricted blood vessels, joint kinematics, prosthetic devices, sports biomechanics, biomaterials, tissue engineering and rehabilitation.

Program Distribution Requirements for the Mechanical Engineering Major with Biomechanical Concentration

Biology and Biotechnology (BB) Coursework (Minimum 2/3 Units)

Students must complete two (2) Biology and Biotechnology (BB) Courses.

Biology and Biotechnology Courses

Item #	Title	Units
BB 1001	Introduction to Biology	1/3
BB 1002	Environmental Biology	1/3
BB 1003/BCB 1003	Exploring Bioinformatics and Computational Biology	1/3
BB 1025	Human Biology	1/3
BB 1035	Biotechnology	1/3
BB 1045	Biodiversity	1/3
BB 2002	Microbiology	1/3
BB 2003	Fundamentals of Microbiology	1/3
BB 2030	Plant Diversity	1/3
BB 2040	Principles of Ecology	1/3
BB 2050	Animal Behavior	1/3
BB 2550	Cell Biology	1/3
BB 2902	Enzymes, Proteins, and Purification	1/6
BB 2903	Anatomy and Physiology	1/6
BB 2904	Ecology, Environment, and Animal Behavior	1/6
BB 2915	Searching for Solutions in Soil: Microbial and Molecular Investigations	1/3
BB 2917	Hunting for Phage	1/3
BB 2920	Genetics	1/3
BB 2950	Molecular Biology	1/3
BB 3003	Medical Microbiology: Plagues of the Modern World, a Case Study Approach	1/3
BB 3010/BCB 3010	Simulation in Biology	1/3
BB 3050	Cancer Biology	1/3
BB 3080	Neurobiology	1/3
BB 3101	Human Anatomy & Physiology: Movement and Communication	1/3
BB 3102	Human Anatomy & Physiology: Transport and Maintenance	1/3
BB 3120	Plant Physiology	1/3
BB 3140	Evolution: Pattern and Process	1/3
BB 3512	Molecular Genetics Lab	1/6
BB 3513	Cell Culture Techniques for Animal Cells	1/6
BB 3515	Physiologic Systems Laboratory	1/3
BB 3517	Fermentation	1/6
BB 3519	Protein Purification	1/6
BB 3521	Microscopy	1/6
BB 3525	Plant Physiology	1/6
BB 3526	Phage Hunters: the Analysis	1/6
BB 3527	Molecular Biology and Genetic Engineering: Approaches and Applications	1/3
BB 3530	Immunotherapies: The Next Generation of Pharmaceuticals	1/3
BB 3570	Cell Culture Models for Tissue Regeneration	1/3
BB 3620	Developmental Biology	1/3
BB 3920	Immunology	1/3
BB 4150	Environmental Change: Problems and Approaches	1/3
BB 4170/CH 4170	Experimental Genetic Engineering	1/3
BB 4190/CH 4190	Regulation of Gene Expression	1/3
BB 4260	Synthetic Biology	1/3
BB 4801/BCB 4001	Bioinformatics	1/3
BB 4900	Capstone Experience in Biology and Biotechnology	1/3

Biomechanical Coursework (Minimum 4/3 Units)

Students must select four (4) courses from BME courses at the 3000-level or higher, except BME 3300, or from the list below:

Biomechanical Related Courses

Item #	Title	Units
BME 4504/ME 4504	Biomechanics	1/3
BME 4606/ME 4606	Biofluids	1/3
BME 4814/ME 4814	Biomaterials	1/3
ME 3501	Elementary Continuum Mechanics	1/3
ME 3506	Rehabilitation Engineering	1/3

Major Qualifying Project (MQP) (Minimum 3/3 Units)

Students must complete a Biomechanical-related Major Qualifying Project (MQP).

Mechanical Engineering Major with Concentration in Engineering Mechanics

Degree Type

Concentration

Students select courses to develop the ability to construct models to analyze, predict, and test the performance of solid structures, fluids, and composite materials under various situations.

Typical MQP topics include: mechanical vibrations, stress and strain analysis, computer methods in engineering mechanics, finite element analysis, and vibration isolation. Departmental testing facilities and computer and software support are available.

Program Distribution Requirements for the Mechanical Engineering Major with Concentration in Engineering Mechanics

Engineering Mechanics Coursework (Minimum 6/3 Units)

Students must complete six (6) courses from the following list:

Engineering Mechanics Related Courses

Item #	Title	Units
AE 2110	Introduction to Incompressible Fluid Dynamics	1/3
AE 3110	Fundamentals of Compressible Fluid Dynamics	1/3
AE 3420	Fundamentals of Aerospace Structures	1/3
BME 4504/ME 4504	Biomechanics	1/3
ME 3501	Elementary Continuum Mechanics	1/3
ME 3506	Rehabilitation Engineering	1/3
ME 4505	Advanced Dynamics	1/3
ME 4506	Mechanical Vibrations	1/3
ME 4512	Introduction to the Finite Element Method	1/3

Major Qualifying Project (MQP) (Minimum 3/3 Units)

Students must complete an Engineering Mechanics related Major Qualifying Project (MQP).

Mechanical Engineering Major with Concentration in Manufacturing

Degree Type
Concentration

Courses are available to support student interest in manufacturing engineering, computer-aided design, computer-aided manufacturing, robotics, vision systems, and a variety of manufacturing processes. Typical MQPs include: robotics, composite materials, factory automation, materials processing, computercontrolled machining, surface metrology, fixturing, machine dynamics, grinding, precision engineering, prototype manufacturing, and additive manufacturing.

Program Distribution Requirements for the Mechanical Engineering Major with Manufacturing Concentration

Students must complete two (2) courses from the following list:

Manufacturing Coursework List 1 (Minimum 2/3 Units)

Item #	Title	Units
ME 1800	Manufacturing Science, Prototyping, and Computer-Controlled Machining	1/3
ME 2820	Materials Processing	1/3
ME 4323	Fundamentals of Drivetrain Systems	1/3
ME 4821	Plastics	1/3

Students must complete two (2) courses from the following list:

Manufacturing Coursework List 2 (Minimum 2/3 Units)

Item #	Title	Units
ES 3011	Control Engineering I	1/3
ME 3820	Computer-Aided Manufacturing	1/3
RBE 4815	Industrial Robotics	1/3

Students must complete two (2) courses from the following list:

Manufacturing Coursework List 3 (Minimum 2/3 Units)

Item #	Title	Units
OIE 2850	Engineering Economics	1/3
OIE 3020	Achieving Effective Operations	1/3
OIE 3410	Materials Management in Supply Chains	1/3
OIE 3420	Quality Planning, Design and Control	1/3

Major Qualifying Project (MQP) (Minimum 3/3 Units)

Students must complete a Manufacturing related Major Qualifying Project (MQP).

Mechanical Engineering Major with Concentration in Materials Science and Engineering

Degree Type
Concentration

Students interested in a strong materials science and engineering component can elect course and project activities in metals, ceramics, polymers, and composite materials with laboratory and project experience using facilities in Washburn Shops and Stoddard Laboratories. Typical MQP topics include: materials processing, materials characterization with X-ray diffraction, optical and electron microscopy, computer modeling of properties and processing, mechanical testing and fatigue, biomaterials, recourse recovery and recycling, photovoltaics, electrochemical energy systems (batteries and fuel cells), corrosion, surface engineering and surface metrology. Another option in the materials program is a Minor in Materials Science and Engineering, which is described under Materials Engineering in this catalog.

Program Distribution Requirements for the Mechanical Engineering Major with Materials Science and Engineering Concentration

Materials Science and Engineering Coursework (Minimum 6/3 Units)

Students must complete six (6) courses from the following list:

Materials Science and Engineering Related Courses

Item #	Title	Units
BME 4814/ME 4814	Biomaterials	1/3
ME 2820	Materials Processing	1/3
ME 4813	Ceramics and Glasses for Engineering Applications	1/3
ME 4821	Plastics	1/3
ME 4832	Corrosion and Corrosion Control	1/3
ME 4840	Physical Metallurgy	1/3
ME 4875/MTE 575	Introduction to Nanomaterials and Nanotechnology	1/3

Major Qualifying Project (MQP) (Minimum 3/3 Units)

Students must complete a Materials Science and Engineering related Major Qualifying Project (MQP).

Mechanical Engineering Major with Concentration in Mechanical Design

Degree Type
Concentration

Courses are available to support development of student interest in the design, analysis, and optimization of an assembly of components which produce a machine. Computer-based techniques are widely used in support of these activities.

Typical MQP topics are: optimum design of mechanical elements, stress analysis of machine components, evaluation and design of industrial machine components and systems, robotics, and computer-aided design and synthesis.

Program Distribution Requirements for the Mechanical Engineering Major with Mechanical Design Concentration

Required Mechanical Design Coursework (Minimum 2/3 Units)

Students must complete the following two courses:

Required Mechanical Design Courses

Item #	Title	Units
ME 3310	Kinematics of Mechanisms	1/3
ME 3320	Design of Machine Elements	1/3

Selected Mechanical Design Coursework (Minimum 4/3 Units)

Students must select four (4) courses from the following list:

Selected Mechanical Design Courses

Item #	Title	Units
ES 1310	Introduction to Computer Aided Design	1/3
ES 3323	Advanced Computer Aided Design	1/3
ME 2300	Introduction to Engineering Design	1/3
ME 3311	Dynamics of Mechanisms and Machines	1/3
ME 3506	Rehabilitation Engineering	1/3
ME 4320	Advanced Engineering Design	1/3
ME 4323	Fundamentals of Drivetrain Systems	1/3
RBE 4322/ME 4322	Modeling and Analysis of Mechatronic Systems	1/3
RBE 4815	Industrial Robotics	1/3

Major Qualifying Project (MQP) (Minimum 3/3 Units)

Students must complete a Mechanical Design related Major Qualifying Project (MQP).

Mechanical Engineering Major with Concentration in Thermal-Fluid Engineering

Degree Type
Concentration

Students study the theoretical and empirical bases of thermodynamics, heat transfer, mass transfer, and fluid flow, as well as the application of these fundamental engineering sciences to energy conversion, environmental control, and vehicular systems.

Typical MQPs include: biological fluid mechanics, laminar/turbulent separation, lifting bodies, heat pipes, electronic component cooling, power cycles, thermal-fluid component analysis and design, and energy storage.

Program Distribution Requirements for the Mechanical Engineering Major with Concentration in Thermal-Fluid Engineering

Selected Thermal-Fluid Engineering Coursework List 1 (Minimum 3/3 Units)

Students must complete three (3) courses from the following list:

List 1

Item #	Title	Units
AE 3110	Fundamentals of Compressible Fluid Dynamics	1/3
AE 4210	Fundamentals of Air-Breathing Propulsion	1/3
ME 3411	Intermediate Fluid Mechanics	1/3
ME 4422	Design and Optimization of Thermal Systems	1/3
ME 4424	Radiation Heat Transfer Application and Design	1/3
ME 4429	Thermofluid Application and Design	1/3

Selected Thermal-Fluid Engineering Coursework List 2 (Minimum 3/3 Units)

Students must select three (3) courses from the following list:

List 2

Item #	Title	Units
AE 4210	Fundamentals of Air-Breathing Propulsion	1/3
BME 4606/ME 4606	Biofluids	1/3
ES 3002	Mass Transfer	1/3
ME 3501	Elementary Continuum Mechanics	1/3
ME 4422	Design and Optimization of Thermal Systems	1/3
ME 4424	Radiation Heat Transfer Application and Design	1/3
ME 4429	Thermofluid Application and Design	1/3
ME 4430	Integrated Thermomechanical Design and Analysis	1/3

Major Qualifying Project (MQP) (Minimum 3/3 Units)

Students must complete a Thermal-Fluid Engineering related Major Qualifying Project (MQP).

Aerospace Engineering

N.A. GATSONIS, DEPARTMENT HEAD

PROFESSORS: M. Demetriou, N. A. Gatsonis
ASSOCIATE PROFESSORS: J. Blandino, R. Cowlagi, N. Karanigaokar, D. Olinger, M. Richman
ASSISTANT PROFESSORS: J. Jayachandran, Y. Lu, Z. Yuan
ASSISTANT TEACHING PROFESSOR: Z. Taillefer

MISSION STATEMENT

The Aerospace Engineering Program seeks to impart to our students strong technical competence in fundamental engineering principles along with specialized competence in aeronautical and astronautical engineering topics. The Program also seeks to foster a student's creative talents with the goal of developing a personal high standard of excellence and professionalism. Finally, the Aerospace Engineering Program seeks to provide to our students an appreciation of the role of the aerospace engineer in society.

PROGRAM EDUCATIONAL OBJECTIVES

The graduates of the Aerospace Engineering Program:

1. Will be successful professionals in aerospace and related engineering areas employed by industry or government.
2. Will be recipients of graduate degrees in aerospace and related engineering areas or in other professional areas.
3. Will become leaders in industry or government due to their mastery of technical concepts, broad preparation in the effective uses of technology, communication, and teamwork, and due to their appreciation of the importance of professional responsibilities and impact of technology on society.

STUDENT OUTCOMES

Graduating students should demonstrate that they attain the following:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3. an ability to communicate effectively with a range of audiences.
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions .
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.
8. knowledge covering one area emphasized – aeronautical engineering or astronautical engineering – and, in addition, knowledge of some topics from the area not emphasized.
9. major engineering design competence that incorporates appropriate engineering standards and multiple constraints, is based on the knowledge and skills acquired in earlier course work, and includes integration of aeronautical or astronautical topics.

Aerospace Engineering Major

Degree Type

Bachelor of Science

The normal period of residency at WPI is 16 terms. In addition to the WPI requirements applicable to all students (see WPI Degree Requirements) students wishing to receive a Bachelor degree in "Aerospace Engineering", must satisfy additional distribution requirements. These requirements apply to 10 units of study in the areas of mathematics, basic sciences, aerospace engineering science and design.

Program Distribution Requirements for the Aerospace Engineering Major

Mathematics and Basic Sciences (Minimum 10/3 Units)

Mathematics (Minimum 6/3 Units)

Must include a minimum of 6/3 units of mathematics (prefix MA) with topics in: differential, integral, vector, multivariable calculus, differential equations, and linear algebra.

Recommended Courses

Item #	Title	Units
MA 1021	Calculus I	1/3
MA 1022	Calculus II	1/3
MA 1023	Calculus III	1/3
MA 1024	Calculus IV	1/3
MA 2051	Ordinary Differential Equations	1/3
MA 2071	Matrices and Linear Algebra I	1/3

Physics (Minimum 2/3 Units)

Must include a minimum of 2/3 units in physics (prefix PH) with topics in mechanics, electricity and magnetism.

Recommended Courses

Item #	Title	Units
PH 1110	General Physics—Mechanics	1/3
PH 1111	Principles of Physics—Mechanics	1/3
PH 1120	General Physics—Electricity and Magnetism	1/3
PH 1121	Principles of Physics—Electricity and Magnetism	1/3

Space Environments (Minimum 1/3 Units)

Must include 1/3 units in space environments (fulfilled by PH/AE 2550 Atmospheric and Space Environments as a Math and Basic Science course or other equivalent course with approval of the AE Program Undergraduate Committee)

Recommended Courses

Item #	Title	Units
PH 2550/AE 2550	Atmospheric and Space Environments	1/3

Chemistry (Minimum 1/3 Units)

Must include 1/3 unit in chemistry (prefix CH).

Recommended Courses

Item #	Title	Units
CH 1010	Chemical Properties, Bonding, and Forces	1/3
CH 1020	Chemical Reactions	1/3

Engineering Topics (Minimum 20/3 Units)

Must include 20/3 units of Engineering Topics, distributed as follows:

Core Aerospace Engineering (Minimum 11/3 Units)

Fluid Dynamics (Minimum 2/3 Units)

2/3 units of Fluid Dynamics, with topics in: incompressible fluid dynamics; compressible fluid dynamics.

Recommended Courses

Item #	Title	Units
AE 2110	Introduction to Incompressible Fluid Dynamics	1/3
AE 3110	Fundamentals of Compressible Fluid Dynamics	1/3

Propulsion and Energy (Minimum 2/3 Units)

2/3 units in Propulsion and Energy, with topics in thermodynamics; heat transfer.

Recommended Courses

Item #	Title	Units
ES 3001	Introduction to Thermodynamics	1/3
ES 3003	Heat Transfer	1/3

Materials and Structures (Minimum 4/3 Units)

4/3 units in Materials and Structures, with topics in: materials; aerospace structures; structural dynamics.

Recommended Courses

Item #	Title	Units
AE 2410	Introduction to Aerospace Structures	1/3
AE 3420	Fundamentals of Aerospace Structures	1/3
AE 4410	Fundamentals of Structural Dynamics	1/3
ES 2001	Introduction to Materials Science	1/3

Flight Dynamics and Controls (Minimum 2/3 Units)

2/3 units in Flight Dynamics and Controls, with topics in: dynamics; controls; aircraft dynamics and control.

Recommended Courses

Item #	Title	Units
AE 2310	Introduction to Aerospace Control Systems	1/3
ES 2503	Introduction to Dynamic Systems	1/3

General Engineering (Minimum 1/3 Units)

1/3 units in General Engineering, with topics in: Experimentation.

Recommended Courses

Item #	Title	Units
ME 3901	Engineering Experimentation	1/3
ME 3902	Project-Based Engineering Experimentation	1/3

Aeronautics *OR* Astronautics Track (Minimum 9/3 Units)

Aeronautics Track

Fluid Dynamics (Minimum 1/3 Units)

1/3 unit in Fluid Dynamics with topics in: aerodynamics.

Recommended Courses

Item #	Title	Units
AE 3120	Fundamentals of Aerodynamics	1/3

Propulsion and Energy (Minimum 1/3 Units)

1/3 unit in Propulsion and Energy, with topics in: air breathing propulsion.

Recommended Courses

Item #	Title	Units
AE 4210	Fundamentals of Air-Breathing Propulsion	1/3

Materials and Structures (Minimum 1/3 Units)

1/3 units in Materials and Structures

Flight Dynamics and Controls (Minimum 1/3 Units)

1/3 unit in Flight Dynamics and Controls.

Recommended Courses

Item #	Title	Units
AE 4310	Fundamentals of Aircraft Dynamics and Control	1/3

Aerospace Design (Minimum 4/3 Units)

4/3 units in Aerospace Design.

Recommended Courses

Item #	Title	Units
AE 4510	Aircraft Design	1/3

Astronautics Elective (Minimum 1/3 Units)

1/3 unit in Astronautics Elective, with topics in: orbital mechanics or rocket propulsion or spacecraft dynamics and control.

Recommended Courses

Item #	Title	Units
AE 2320	Introduction to Orbital Mechanics	1/3
AE 3310	Fundamentals of Navigation and Communication	1/3
AE 4220	Fundamentals of Rocket Propulsion	1/3
AE 4320	Fundamentals of Spacecraft Dynamics and Control	1/3

Astronautics Track

Propulsion and Energy (Minimum 1/3 Units)

1/3 unit in Propulsion and Energy, with topics in: rocket propulsion.

Recommended Courses

Item #	Title	Units
AE 4220	Fundamentals of Rocket Propulsion	1/3

Dynamics and Control (Minimum 3/3 Units)

3/3 units in Dynamics and Control, with topics in: orbital mechanics; spacecraft dynamics and control; navigation and communication.

Recommended Courses

Item #	Title	Units
AE 2320	Introduction to Orbital Mechanics	1/3
AE 3310	Fundamentals of Navigation and Communication	1/3
AE 4320	Fundamentals of Spacecraft Dynamics and Control	1/3

Aerospace Design (Minimum 4/3 Units)

4/3 units in Aerospace Design.

Recommended Courses

Item #	Title	Units
AE 4520	Spacecraft and Mission Design	1/3

Aeronautics Elective (Minimum 1/3 Units)

1/3 unit in Aeronautics Elective, with topics in: aerodynamics or air breathing propulsion or composite materials.

Recommended Courses

Item #	Title	Units
AE 3120	Fundamentals of Aerodynamics	1/3
AE 4210	Fundamentals of Air-Breathing Propulsion	1/3

Major Qualifying Projects

The Aerospace Engineering Program provides opportunities, resources and organization for Major Qualifying Projects (MQPs). The MQPs involve the design of an aerospace system, component, or process to meet desired needs that incorporates appropriate engineering standards and multiple constraints, is based on the knowledge and skills acquired in earlier course work, and include the integration of aeronautical and/or astronautical engineering topics. MQPs are conducted in a dedicated lab or in one of the research laboratories of the Aerospace Engineering Program and serve as a vehicle for integration of undergraduate studies with current research activities. Some MQPs are also conducted in collaboration with industry or government research centers. All students present their MQP in a conference held at WPI on Project Presentation Day. Students are also encouraged and often supported to participate in student and professional conferences, as well as national design competitions. (https://www.wpi.edu/academics/departments/aerospace-engineering)

Item #	Title	Units
AE 3120	Fundamentals of Aerodynamics	1/3
AE 4210	Fundamentals of Air-Breathing Propulsion	1/3

Aerospace Engineering Minor

Degree Type

Minor

For students who are not AE majors and are interested in broadening their exposure to, and understanding of, aerospace engineering, the Aerospace Engineering Program offers a Minor in Aerospace Engineering.

Successful candidates for the Minor in AE must meet the following requirements:

Program Distribution Requirements for the Aerospace Engineering Minor

Aerospace Engineering Courses (Minimum 6/3 Units)

Complete two units of work from courses with the prefix AE as outlined in the lists below. Of this work, at least 2/3 unit must be in 4000-level AE courses.

Aerodynamics and Propulsion

Item #	Title	Units
AE 2320	Introduction to Orbital Mechanics	1/3
AE 3110	Fundamentals of Compressible Fluid Dynamics	1/3
AE 3120	Fundamentals of Aerodynamics	1/3
AE 4210	Fundamentals of Air-Breathing Propulsion	1/3
AE 4220	Fundamentals of Rocket Propulsion	1/3

Aerospace Materials and Structures

Item #	Title	Units
AE 3420	Fundamentals of Aerospace Structures	1/3
AE 3430	Fundamentals of Composite Materials	1/3
AE 4410	Fundamentals of Structural Dynamics	1/3

Aerospace Vehicle Dynamics, Stability and Control

Item #	Title	Units
AE 3310	Fundamentals of Navigation and Communication	1/3
AE 4310	Fundamentals of Aircraft Dynamics and Control	1/3
AE 4320	Fundamentals of Spacecraft Dynamics and Control	1/3

Major Aerospace Design Experience

Item #	Title	Units
AE 4510	Aircraft Design	1/3
AE 4520	Spacecraft and Mission Design	1/3

Biomedical Engineering

K. L. BILLIAR, HEAD; K. TROY, ASSOCIATE HEAD

PROFESSORS: K. Billiar, B. Faber, S. Ji, G. D. Pins, K. Troy

ASSOCIATE PROFESSOR: D. Albrecht, J. Coburn

ASSISTANT PROFESSORS: D. Alatalo, Y. Ding, A. Lammert, S. Mensah, Z.A. Wei, C. Whittington, H. Zhang

ASSOCIATE TEACHING PROFESSORS: S. Ambady, A. Z. Reidinger

ASSISTANT TEACHING PROFESSORS: T. Afzal, J. Obayemi

PROFESSOR OF PRACTICE: R. L. Page

ASSOCIATED FACULTY: S. Olson (MA), H. Ault (TGS), C. Brown (ME), N. Burnham (PH), E. Clancy (ECE), T. Dominko (BB), L. Fichera (RBE), G. Fischer (RBE), M. Fofana (ME), U. Guler (ECE), Y. Liu (ME), R. Ludwig (ECE), L. Polizzotto (BME), S. Roberts (CHE), A. Sabuncu (ME), A. Salifu (ME), B. Savilonis (ME), S. Shivkumar (ME), E. Stewart (CHE), J. Sullivan (ME), D. Tang (MA), P. Weathers (BB), Q. Wen (PH), E. Young (CHE), Y. Zheng (ME)

EMERITUS PROFESSORS: Y. Mendelson, R. A. Peura

Mission Statement

The Biomedical Engineering Department prepares students for rewarding careers in the health care industry or professional programs in biomedical research or medicine.

Educational Objectives

The educational objectives of the Biomedical Engineering Program, which embrace the WPI educational philosophy, are that our alumni 1) have successful careers, 2) apply sound science and engineering principles to impact the field of biomedical sciences in a socially and ethically responsible manner and, 3) will meet the changing needs of the profession through lifelong learning.

Student Outcomes

The Biomedical Engineering Program has established the following student outcomes in support of the educational objectives of our department. The general and specific program criteria meet the requirements for Biomedical Engineering accreditation by ABET (The Accreditation Board for Engineering and Technology). Accordingly, students graduating from the Biomedical Engineering Program will demonstrate:

1. An ability to identify, formulate, and solve complex engineering problems at the interface of engineering and biology by applying principles of engineering, science, and mathematics
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. An ability to communicate effectively with a range of audiences
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data from living and non-living systems, and use engineering judgment to draw conclusions
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies
8. An understanding of biology and physiology
9. An ability to address the problems associated with the interaction between living and non-living materials and systems.

Biomedical engineering is the application of engineering principles to the solution of problems in biology and medicine for the enhancement of health care. Students choose this field in order:

- to be of service to people;
- to work with living systems; and
- to apply advanced technology to solve complex problems of medicine.

Biomedical engineers may be called upon to design instruments and devices, to integrate knowledge from many sources in order to develop new procedures, or to pursue research in order to acquire knowledge needed to solve problems. The major culminates in a Major Qualifying Project, which requires that each student apply his or her engineering background to a suitable biomedical problem, generally in association with the University of Massachusetts Medical School, Tufts University School of Veterinary Medicine, one of the local hospitals, or a medical device company.

Each student's program will be developed individually with an advisor to follow the Biomedical Engineering program chart. WPI requirements applicable to all students must also be met. See page 7.

Biomedical engineering is characterized by the following types of activity in the field:

1. Uncovering new knowledge in areas of biological science and medical practice by applying engineering methods;
2. Applying engineering principles to identify unmet needs in the medical and biological fields and implement high impact innovative solutions;
3. Designing and developing patient-related instrumentation, biosensors, prostheses, biocompatible materials, and diagnostic and therapeutic devices; and bioengineered tissues and organs;
4. Analyzing, designing, and implementing improved health-care delivery systems and apparatus in order to improve patient care and reduce health-care costs in contexts ranging from individual doctors' offices to advanced clinical diagnostic and therapeutic centers.

The modeling of biological systems is an example of applying engineering analytical techniques to better understand the dynamic function of biological systems. The body has a complex feedback control system with multiple subsystems that interact with each other. The application of modeling, computer simulation, and control theory provides insights into the function of these bodily processes.

Recently, there has been increased emphasis on the application of the biomedical engineering principles embodied in the third and fourth areas listed above. Examples of the third area include:

- designing and developing tissues and organs;
- development of implantable biomaterials;
- design of an implantable power source;
- design of transducers to monitor the heart's performance;
- development of electronic circuitry to control the system;
- bench and field testing of devices in animals;
- application of new technology to rehabilitation engineering.

The fourth area involves closer contact with the patient and health-care delivery system. This area is commonly referred to as Clinical Engineering. The engineer in the clinical environment normally has responsibility for the medical instrumentation and equipment including:

- writing procurement specifications in consultation with medical and hospital staff;
- inspecting equipment for safe operation and conformance with specifications;
- training medical personnel in proper use of equipment;
- testing within hospital for electrical safety; and
- adaptation of instrumentation to specific applications.

Biomedical engineering projects are available in WPI's Goddard Hall and Higgins Laboratories, the Life Sciences and Bioengineering Center at Gateway Park as well as at the affiliated institutions previously listed.

The second digit for Biomedical Engineering course numbers is coded as follows:

0 — Bioinstrumentation, Biosignals, Introduction
1 — Physiology
2 — Bioelectric, Bioimaging
3 — Design
4 — Communication
5 — Biomechanics, Biological Systems
6 — Biofluids
7 — Cellular and molecular
8 — Biomaterials
NOTE: Courses listed in previous catalogs with "BE" as the prefix and the same course number as below are considered to be the SAME COURSE.

Biomedical Engineering Major

Degree Type

Bachelor of Science

Program Distribution Requirements for the Biomedical Engineering Major

The normal period of residency at WPI is 16 terms. In addition to the WPI requirements applicable to all students, a biomedical engineer needs a solid background in mathematics, physical and life sciences. The distribution requirements are satisfied as follows.

Mathematics (Minimum 6/3 Units)

Mathematics must include differential and integral calculus, differential equations and statistics.

a. Differential and integral calculus

Item #	Title	Units
MA 1021	Calculus I	1/3
MA 1022	Calculus II	1/3
MA 1023	Calculus III	1/3
MA 1024	Calculus IV	1/3
MA 1033	Theoretical Calculus III	1/3
MA 1034	Theoretical Calculus IV	1/3
MA 1120	Calculus II (Semester Version)	1/3

b. Differential equations

Item #	Title	Units
MA 2051	Ordinary Differential Equations	1/3

c. Statistics options

Item #	Title	Units
MA 2610	Applied Statistics for the Life Sciences	1/3
MA 2611	Applied Statistics I	1/3

For the MA requirement, advanced courses within a-c may be allowed, but require department approval (via the course substitution form).

Basic Science (Minimum 6/3 Units)

Basic Science must include 2/3 unit from each of the following areas: BB, CH and PH. At least 1/3 unit of BB coursework must be 2000+ level.

Biology and Biochemistry

1000 Level Courses

Item #	Title	Units
BB 1001	Introduction to Biology	1/3
BB 1002	Environmental Biology	1/3
BB 1003/BCB 1003	Exploring Bioinformatics and Computational Biology	1/3
BB 1025	Human Biology	1/3
BB 1035	Biotechnology	1/3
BB 1045	Biodiversity	1/3

2000 Level Courses

Item #	Title	Units
BB 2002	Microbiology	1/3
BB 2003	Fundamentals of Microbiology	1/3
BB 2030	Plant Diversity	1/3
BB 2040	Principles of Ecology	1/3
BB 2050	Animal Behavior	1/3
BB 2550	Cell Biology	1/3
BB 2902	Enzymes, Proteins, and Purification	1/6
BB 2903	Anatomy and Physiology	1/6
BB 2904	Ecology, Environment, and Animal Behavior	1/6
BB 2915	Searching for Solutions in Soil: Microbial and Molecular Investigations	1/3
BB 2917	Hunting for Phage	1/3
BB 2920	Genetics	1/3
BB 2950	Molecular Biology	1/3

3000 Level Courses

Item #	Title	Units
BB 3003	Medical Microbiology: Plagues of the Modern World, a Case Study Approach	1/3
BB 3010/BCB 3010	Simulation in Biology	1/3
BB 3050	Cancer Biology	1/3
BB 3080	Neurobiology	1/3
BB 3101	Human Anatomy & Physiology: Movement and Communication	1/3
BB 3102	Human Anatomy & Physiology: Transport and Maintenance	1/3
BB 3120	Plant Physiology	1/3
BB 3140	Evolution: Pattern and Process	1/3
BB 3512	Molecular Genetics Lab	1/6
BB 3513	Cell Culture Techniques for Animal Cells	1/6
BB 3515	Physiologic Systems Laboratory	1/3
BB 3517	Fermentation	1/6
BB 3519	Protein Purification	1/6
BB 3521	Microscopy	1/6
BB 3525	Plant Physiology	1/6
BB 3526	Phage Hunters: the Analysis	1/6
BB 3527	Molecular Biology and Genetic Engineering: Approaches and Applications	1/3
BB 3530	Immunotherapies: The Next Generation of Pharmaceuticals	1/3
BB 3570	Cell Culture Models for Tissue Regeneration	1/3
BB 3620	Developmental Biology	1/3
BB 3920	Immunology	1/3

4000 Level Courses

Item #	Title	Units
BB 4150	Environmental Change: Problems and Approaches	1/3
BB 4170/CH 4170	Experimental Genetic Engineering	1/3
BB 4190/CH 4190	Regulation of Gene Expression	1/3
BB 4260	Synthetic Biology	1/3
BB 4801/BCB 4001	Bioinformatics	1/3
BB 4900	Capstone Experience in Biology and Biotechnology	1/3

Chemistry and Biochemistry

1000 Level Courses

Item #	Title	Units
CH 1010	Chemical Properties, Bonding, and Forces	1/3
CH 1020	Chemical Reactions	1/3
CH 1030	Kinetics, Equilibrium and Thermodynamics	1/3
CH 1040	Spectroscopy in Organic and Polymer Chemistry	1/3

2000 Level Courses

Item #	Title	Units
CH 2310	Organic Chemistry I	1/3
CH 2320	Organic Chemistry II	1/3
CH 2330	Organic Chemistry III	1/3
CH 2360	Organic Laboratory	1/3
CH 2640	Experimental Chemistry I: Instrumental Analysis	1/3
CH 2650	Modern Physical Chemistry Methods	1/3
CH 2660	Organic Synthesis and Analysis Laboratory	1/3
CH 2670	Investigation of Coordination Complexes Through Inquiry	1/3

3000 Level Courses

Item #	Title	Units
CH 3310	Advanced Organic Chemistry	1/3
CH 3410	Structure, Bonding, and Reactivity in Inorganic Chemistry	1/3
CH 3510	Chemical Thermodynamics	1/3
CH 3530	Quantum Chemistry	1/3
CH 3550	Chemical Dynamics	1/3

4000 Level Courses

Item #	Title	Units
BB 4170/CH 4170	Experimental Genetic Engineering	1/3
BB 4190/CH 4190	Regulation of Gene Expression	1/3
CH 4110	Protein Structure and Function	1/3
CH 4120	Lipids and Biomembrane Functions	1/3
CH 4130	Nucleic Acids and Bioinformation	1/3
CH 4140	Metabolism and Disease	1/3
CH 4150	Enzymology and Protein Characterization Laboratory	1/3
CH 4160	Membrane Biophysics	1/3
CH 4330	Organic Synthesis	1/3
CH 4420	Principles and Applications of Group Theory in Chemistry	1/3
CH 4520	Chemical Statistical Mechanics	1/3

Physics

1000 Level Courses

Item #	Title	Units
PH 1110	General Physics—Mechanics	1/3
PH 1111	Principles of Physics—Mechanics	1/3
PH 1120	General Physics—Electricity and Magnetism	1/3
PH 1121	Principles of Physics—Electricity and Magnetism	1/3
PH 1130	Modern Physics	1/3
PH 1140	Oscillations and Waves	1/3
PH 1150	Introductory Physics of Living Systems	1/3

2000 Level Courses

Item #	Title	Units
PH 2101	Principles of Thermodynamics	1/3
PH 2201	Intermediate Mechanics I	1/3
PH 2202	Intermediate Mechanics II	1/3
PH 2301	Electromagnetic Fields	1/3
PH 2501	Photonics	1/3
PH 2502	Lasers	1/3
PH 2510	Atomic Force Microscopy	1/3
PH 2520	Introduction to Astrophysics	1/3
PH 2540	Solar Systems	1/3
PH 2550/AE 2550	Atmospheric and Space Environments	1/3
PH 2601	Photonics Laboratory	1/3
PH 2651	Intermediate Physics Laboratory	1/3

3000 Level Courses

Item #	Title	Units
PH 3206	Statistical Physics	1/3
PH 3301	Electromagnetic Theory	1/3
PH 3401	Quantum Mechanics I	1/3
PH 3402	Quantum Mechanics II	1/3
PH 3501	Relativity	1/3
PH 3502	Solid State Physics	1/3
PH 3503	Nuclear Physics	1/3
PH 3504	Optics	1/3

4000 Level Courses

Item #	Title	Units
PH 4201/PH 511	Advanced Classical Mechanics	1/3

Supplemental Science (Minimum 1/3 Units)

Supplemental Science must include 1/3 unit from BB, CH, CS, MA, PH, or FY courses that satisfy BB, CH, CS, MA or PH.

Biology and Biochemistry

1000 Level Courses

Item #	Title	Units
BB 1001	Introduction to Biology	1/3
BB 1002	Environmental Biology	1/3
BB 1003/BCB 1003	Exploring Bioinformatics and Computational Biology	1/3
BB 1025	Human Biology	1/3
BB 1035	Biotechnology	1/3
BB 1045	Biodiversity	1/3

2000 Level Courses

Item #	Title	Units
BB 2002	Microbiology	1/3
BB 2003	Fundamentals of Microbiology	1/3
BB 2030	Plant Diversity	1/3
BB 2040	Principles of Ecology	1/3
BB 2050	Animal Behavior	1/3
BB 2550	Cell Biology	1/3
BB 2902	Enzymes, Proteins, and Purification	1/6
BB 2903	Anatomy and Physiology	1/6
BB 2904	Ecology, Environment, and Animal Behavior	1/6
BB 2915	Searching for Solutions in Soil: Microbial and Molecular Investigations	1/3
BB 2917	Hunting for Phage	1/3
BB 2920	Genetics	1/3
BB 2950	Molecular Biology	1/3

3000 Level Courses

Item #	Title	Units
BB 3003	Medical Microbiology: Plagues of the Modern World, a Case Study Approach	1/3
BB 3010/BCB 3010	Simulation in Biology	1/3
BB 3050	Cancer Biology	1/3
BB 3080	Neurobiology	1/3
BB 3101	Human Anatomy & Physiology: Movement and Communication	1/3
BB 3102	Human Anatomy & Physiology: Transport and Maintenance	1/3
BB 3120	Plant Physiology	1/3
BB 3140	Evolution: Pattern and Process	1/3
BB 3512	Molecular Genetics Lab	1/6
BB 3513	Cell Culture Techniques for Animal Cells	1/6
BB 3515	Physiologic Systems Laboratory	1/3
BB 3517	Fermentation	1/6
BB 3519	Protein Purification	1/6
BB 3521	Microscopy	1/6
BB 3525	Plant Physiology	1/6
BB 3526	Phage Hunters: the Analysis	1/6
BB 3527	Molecular Biology and Genetic Engineering: Approaches and Applications	1/3
BB 3530	Immunotherapies: The Next Generation of Pharmaceuticals	1/3
BB 3570	Cell Culture Models for Tissue Regeneration	1/3
BB 3620	Developmental Biology	1/3
BB 3920	Immunology	1/3

4000 Level Courses

Item #	Title	Units
BB 4150	Environmental Change: Problems and Approaches	1/3
BB 4170/CH 4170	Experimental Genetic Engineering	1/3
BB 4190/CH 4190	Regulation of Gene Expression	1/3
BB 4260	Synthetic Biology	1/3
BB 4801/BCB 4001	Bioinformatics	1/3
BB 4900	Capstone Experience in Biology and Biotechnology	1/3

Chemistry and Biochemistry

1000 Level Courses

Item #	Title	Units
CH 1010	Chemical Properties, Bonding, and Forces	1/3
CH 1020	Chemical Reactions	1/3
CH 1030	Kinetics, Equilibrium and Thermodynamics	1/3
CH 1040	Spectroscopy in Organic and Polymer Chemistry	1/3

2000 Level Courses

Item #	Title	Units
CH 2310	Organic Chemistry I	1/3
CH 2320	Organic Chemistry II	1/3
CH 2330	Organic Chemistry III	1/3
CH 2360	Organic Laboratory	1/3
CH 2640	Experimental Chemistry I: Instrumental Analysis	1/3
CH 2650	Modern Physical Chemistry Methods	1/3
CH 2660	Organic Synthesis and Analysis Laboratory	1/3
CH 2670	Investigation of Coordination Complexes Through Inquiry	1/3

3000 Level Courses

Item #	Title	Units
CH 3310	Advanced Organic Chemistry	1/3
CH 3410	Structure, Bonding, and Reactivity in Inorganic Chemistry	1/3
CH 3510	Chemical Thermodynamics	1/3
CH 3530	Quantum Chemistry	1/3
CH 3550	Chemical Dynamics	1/3

4000 Level Courses

Item #	Title	Units
BB 4170/CH 4170	Experimental Genetic Engineering	1/3
BB 4190/CH 4190	Regulation of Gene Expression	1/3
CH 4110	Protein Structure and Function	1/3
CH 4120	Lipids and Biomembrane Functions	1/3
CH 4130	Nucleic Acids and Bioinformation	1/3
CH 4140	Metabolism and Disease	1/3
CH 4150	Enzymology and Protein Characterization Laboratory	1/3
CH 4160	Membrane Biophysics	1/3
CH 4330	Organic Synthesis	1/3
CH 4420	Principles and Applications of Group Theory in Chemistry	1/3
CH 4520	Chemical Statistical Mechanics	1/3

Computer Science

1000 Level Courses

Item #	Title	Units
CS 1004	Introduction to Programming for Non-Majors	1/3
CS 1101	Introduction to Program Design	1/3
CS 1102	Accelerated Introduction to Program Design	1/3

2000 Level Courses

Item #	Title	Units
CS 2011	Introduction to Machine Organization and Assembly Language	1/3
CS 2022/MA 2201	Discrete Mathematics	1/3
CS 2102	Object-Oriented Design Concepts	1/3
CS 2103	Accelerated Object-Oriented Design Concepts	1/3
CS 2119	Application Building with Object-Oriented Concepts	1/3
CS 2223	Algorithms	1/3
CS 2301	Systems Programming for Non-Majors	1/3
CS 2303	Systems Programming Concepts	1/3

3000 Level Courses

Item #	Title	Units
CS 3013	Operating Systems	1/3
CS 3041	Human-Computer Interaction	1/3
CS 3043	Social Implications of Information Processing	1/3
CS 3133	Foundations of Computer Science	1/3
CS 3431	Database Systems I	1/3
CS 3516	Computer Networks	1/3
CS 3733	Software Engineering	1/3

4000 Level Courses

Item #	Title	Units
BCB 4002/CS 4802	Biovisualization	1/3
BCB 4003/CS 4803	Biological and Biomedical Database Mining	1/3
CS 4032/MA 3257	Numerical Methods for Linear and Nonlinear Systems	1/3
CS 4033/MA 3457	Numerical Methods for Calculus and Differential Equations	1/3
CS 4099	Special Topics in Computer Science	1/3
CS 4100/IMGD 4100	Artificial Intelligence for Interactive Media and Games	1/3
CS 4120	Analysis of Algorithms	1/3
CS 4123	Theory of Computation	1/3
CS 4233	Object-Oriented Analysis and Design	1/3
CS 4241	Webware: Computational Technology for Network Information Systems	1/3
CS 4300/IMGD 4300	Graphics, Simulation, and Aesthetics	1/3
CS 4341	Introduction to Artificial Intelligence	1/3
CS 4342	Machine Learning	1/3
CS 4401	Software Security Engineering	1/3
CS 4404	Tools and Techniques in Computer Network Security	1/3
CS 4432	Database Systems II	1/3
CS 4433/DS 4433	Big Data Management and Analytics	1/3
CS 4445	Data Mining and Knowledge Discovery in Databases	1/3
CS 4513	Distributed Computing Systems	1/3
CS 4515	Computer Architecture	1/3
CS 4516	Advanced Computer Networks	1/3
CS 4518	Mobile and Ubiquitous Computing	1/3
CS 4533	Techniques of Programming Language Translation	1/3
CS 4536	Programming Languages	1/3
CS 4731	Computer Graphics	1/3
CS 4732	Computer Animation	1/3
CS 4801/ECE 4802	Introduction to Cryptography and Communication Security	1/3
CS 4804	Data Visualization	1/3
MA 3457/CS 4033	Numerical Methods for Calculus and Differential Equations	1/3

Mathematics

1000 Level Courses

Item #	Title	Units
MA 1020	Calculus I with Preliminary Topics	1/3
MA 1021	Calculus I	1/3
MA 1022	Calculus II	1/3
MA 1023	Calculus III	1/3
MA 1024	Calculus IV	1/3
MA 1033	Theoretical Calculus III	1/3
MA 1034	Theoretical Calculus IV	1/3
MA 1120	Calculus II (Semester Version)	1/3
MA 1801	Denksport	1/12
MA 1971	Bridge to Higher Mathematics	1/3

2000 Level Courses

Item #	Title	Units
CS 2022/MA 2201	Discrete Mathematics	1/3
MA 2051	Ordinary Differential Equations	1/3
MA 2071	Matrices and Linear Algebra I	1/3
MA 2072	Accelerated Matrices and Linear Algebra I	1/3
MA 2073	Matrices and Linear Algebra II	1/3
MA 2210	Mathematical Methods in Decision Making	1/3
MA 2211	Theory of Interest I	1/3
MA 2212	Theory of Interest II	1/3
MA 2251	Vector and Tensor Calculus	1/3
MA 2271	Graph Theory	1/3
MA 2273	Combinatorics	1/3
MA 2431	Mathematical Modeling with Ordinary Differential Equations	1/3
MA 2610	Applied Statistics for the Life Sciences	1/3
MA 2611	Applied Statistics I	1/3
MA 2612	Applied Statistics II	1/3
MA 2621	Probability for Applications	1/3
MA 2631	Probability Theory	1/3

3000 Level Courses

Item #	Title	Units
CS 4032/MA 3257	Numerical Methods for Linear and Nonlinear Systems	1/3
CS 4033/MA 3457	Numerical Methods for Calculus and Differential Equations	1/3
MA 3212	Actuarial Mathematics I	1/3
MA 3213	Actuarial Mathematics II	1/3
MA 3231	Linear Programming	1/3
MA 3233	Discrete Optimization	1/3
MA 3457/CS 4033	Numerical Methods for Calculus and Differential Equations	1/3
MA 3471	Advanced Ordinary Differential Equations	1/3
MA 3475	Calculus of Variations	1/3
MA 3627	Introduction to the Design and Analysis of Experiments	1/3
MA 3631	Mathematical Statistics	1/3
MA 3823	Group Theory	1/3
MA 3825	Rings and Fields	1/3
MA 3831	Principles of Real Analysis I	1/3
MA 3832	Principles of Real Analysis II	1/3

4000 Level Courses

Item #	Title	Units
BCB 4004/MA 4603	Statistical Methods in Genetics and Bioinformatics	1/3
DS 4635/MA 4635	Data Analytics and Statistical Learning	1/3
MA 4213	Loss Models I - Risk Theory	1/3
MA 4214	Loss Models II - Survival Models	1/3
MA 4216	Actuarial Seminar	
MA 4222	Top Algorithms in Applied Mathematics	1/3
MA 4235	Mathematical Optimization	1/3
MA 4237	Probabilistic Methods in Operations Research	1/3
MA 4291	Applied Complex Variables	1/3
MA 4411	Numerical Analysis of Differential Equations	1/3
MA 4451	Boundary Value Problems	1/3
MA 4473	Partial Differential Equations	1/3
MA 4631	Probability and Mathematical Statistics I	1/3
MA 4632	Probability and Mathematical Statistics II	1/3
MA 4891	Topics in Mathematics	1/3
MA 4892	Topics in Actuarial Mathematics	1/3
MA 4895	Differential Geometry	1/3

Physics

1000 Level Courses

Item #	Title	Units
PH 1110	General Physics—Mechanics	1/3
PH 1111	Principles of Physics—Mechanics	1/3
PH 1120	General Physics—Electricity and Magnetism	1/3
PH 1121	Principles of Physics—Electricity and Magnetism	1/3
PH 1130	Modern Physics	1/3
PH 1140	Oscillations and Waves	1/3
PH 1150	Introductory Physics of Living Systems	1/3

2000 Level Courses

Item #	Title	Units
PH 2101	Principles of Thermodynamics	1/3
PH 2201	Intermediate Mechanics I	1/3
PH 2202	Intermediate Mechanics II	1/3
PH 2301	Electromagnetic Fields	1/3
PH 2501	Photonics	1/3
PH 2502	Lasers	1/3
PH 2510	Atomic Force Microscopy	1/3
PH 2520	Introduction to Astrophysics	1/3
PH 2540	Solar Systems	1/3
PH 2550/AE 2550	Atmospheric and Space Environments	1/3
PH 2601	Photonics Laboratory	1/3
PH 2651	Intermediate Physics Laboratory	1/3

3000 Level Courses

Item #	Title	Units
PH 3206	Statistical Physics	1/3
PH 3301	Electromagnetic Theory	1/3
PH 3401	Quantum Mechanics I	1/3
PH 3402	Quantum Mechanics II	1/3
PH 3501	Relativity	1/3
PH 3502	Solid State Physics	1/3
PH 3503	Nuclear Physics	1/3
PH 3504	Optics	1/3

4000 Level Courses

Item #	Title	Units
PH 4201/PH 511	Advanced Classical Mechanics	1/3

First Year Courses

FY courses must satisfy BB, CH, CS, MA or PH.

1000 Level Courses

Item #	Title	Units
FY 1100 & FY 1101	The Great Problems Seminars	1/3
FY 1800	Discovering Majors and Careers	1/12

Computer Science (Minimum 1/3 Units)

Must include 1/3 unit in basic computer programming

BME 1004, or Equivalent

Item #	Title	Units
BME 1004	Introduction to Programming in Matlab	1/3
CS 1004	Introduction to Programming for Non-Majors	1/3
CS 1101	Introduction to Program Design	1/3
CS 1102	Accelerated Introduction to Program Design	1/3
CS 2301	Systems Programming for Non-Majors	1/3
CS 2303	Systems Programming Concepts	1/3

Physiology (Minimum 1/3 Units)

Must include 1/3 unit of human physiology selected from the list below, or equivalent.

BME 3111, BB 3101, BB 3102, BB 3515, or equivalent.

Item #	Title	Units
BB 3101	Human Anatomy & Physiology: Movement and Communication	1/3
BB 3102	Human Anatomy & Physiology: Transport and Maintenance	1/3
BB 3515	Physiologic Systems Laboratory	1/3
BME 3111	Physiology and Engineering	1/3

Biomedical Engineering and Engineering (Minimum 14/3 Units)

A maximum of 1/3 unit of coursework at the 500 level or 5000 level can count towards the Biomedical Engineering and Engineering requirement.

14/3 unit of engineering coursework as specified in the list below, with the following distribution

A. 3/3 unit of 2000+ level in Engineering

2000+ Level Biomedical Engineering Courses

Item #	Title	Units
BME 2001	Introduction to Biomaterials	1/3
BME 2210	Biomedical Signals, Instruments and Measurements	1/3
BME 2211	Biomedical Data Analysis	1/3
BME 2502	Introduction to Biomechanics: Stress Analysis	1/3
BME 2610	Introduction to Bioprocess Engineering	1/3
BME 3012	Biomedical Sensors Laboratory	1/6
BME 3013	Biomedical Instrumentation Laboratory	1/6
BME 3014	Physiological Signals Laboratory I: Techniques	1/6
BME 3111	Physiology and Engineering	1/3
BME 3112	Human Physiology for Biomedical Engineers	1/3
BME 3300	Biomedical Engineering Design	1/3
BME 3503	Skeletal Biomechanics Laboratory	1/6
BME 3505	Solid Biomechanics Laboratory: Techniques	1/6
BME 3506	Solid Biomechanics Laboratory: Applications	1/6
BME 3605	Biotransport Laboratory II: Applications	1/6
BME 3610	Transport Analysis in Bioengineering	1/3
BME 3811	Biomaterials Lab	1/6
BME 3813	Cellular Engineering Lab	1/6
BME 4011/ECE 4011	Biomedical Signal Analysis	1/3
BME 4023/ECE 4023	Biomedical Instrumentation Design	1/3
BME 4201	Biomedical Imaging	1/3
BME 4300	MQP Capstone Design	1/6
BME 4503	Computational Biomechanics	1/3
BME 4504/ME 4504	Biomechanics	1/3
BME 4606/ME 4606	Biofluids	1/3
BME 4701	Cell and Molecular Bioengineering	1/3
BME 4814/ME 4814	Biomaterials	1/3
BME 4828	Biomaterials-Tissue Interactions	1/3
BME 4831	Drug Delivery	1/3

2000+ Level Chemical Engineering Courses

Item #	Title	Units
CE 4063/CHE 4063	Transport & Transformations in the Environment	1/3
CHE 2011	Chemical Engineering Fundamentals	1/3
CHE 2012	Elementary Chemical Processes	1/3
CHE 2013	Applied Chemical Engineering Thermodynamics	1/3
CHE 2014	Advanced Chemical Processes	1/3
CHE 3201	Kinetics and Reactor Design	1/3
CHE 3301	Introduction to Biological Engineering	1/3
CHE 3501	Applied Mathematics in Chemical Engineering	1/3
CHE 3702	Energy Challenges in the 21st Century	1/3
CHE 3722	Bioenergy	1/3
CHE 4401	Unit Operations of Chemical Engineering I	1/3
CHE 4402	Unit Operations of Chemical Engineering II	1/3
CHE 4403	Chemical Engineering Design	1/3
CHE 4404	Chemical Plant Design Project	1/3
CHE 4405	Chemical Process Dynamics and Control Laboratory	1/3
CHE 4410	Chemical Process Safety Design	1/3

2000+ Level Civil and Environmental Engineering Courses (Excluding CE 3022)

Item #	Title	Units
CE 2000	Analytical Mechanics I	1/3
CE 2001	Analytical Mechanics II	1/3
CE 2002	Introduction to Analysis and Design	1/3
CE 2020	Surveying	1/3
CE 3006	Design of Steel Structures	1/3
CE 3008	Design of Reinforced Concrete Structures	1/3
CE 3010	Structural Engineering	1/3
CE 3020	Project Management	1/3
CE 3022	Legal Aspects of Professional Practice	1/3
CE 3025	Project Evaluation	1/3
CE 3026	Materials of Construction	1/3
CE 3030	Fundamentals of Civil Engineering Autocad	1/3
CE 3031	Building Information Modeling: Software Tools and Principles	1/3
CE 3041	Soil Mechanics	1/3
CE 3044	Foundation Engineering	1/3
CE 3050	Traffic Engineering	1/3
CE 3051	Pavement Engineering	1/3
CE 3059	Environmental Engineering	1/3
CE 3060	Water Treatment	1/3
CE 3061	Sustainable Wastewater Engineering: Treatment and Reuse	1/3
CE 3062	Hydraulics	1/3
CE 3070	Urban and Environmental Planning	1/3
CE 3074	Environmental Analysis	1/3
CE 4007	Matrix Analysis of Structures	1/3
CE 4060	Environmental Engineering Laboratory	1/3
CE 4061	Hydrology	1/3
CE 4063/CHE 4063	Transport & Transformations in the Environment	1/3
CE 4071	Land Use Development and Controls	1/3
CE 4600	Hazardous and Industrial Waste Management	1/3
CE 4610	Solid Waste Engineering	1/3

2000+ Level Electrical and Computer Engineering Courses

Item #	Title	Units
BME 4011/ECE 4011	Biomedical Signal Analysis	1/3
BME 4023/ECE 4023	Biomedical Instrumentation Design	1/3
CS 4801/ECE 4802	Introduction to Cryptography and Communication Security	1/3
ECE 2010	Introduction to Electrical and Computer Engineering	1/3
ECE 2019	Sensors, Circuits, and Systems	1/3
ECE 2029	Introduction to Digital Circuit Design	1/3
ECE 2049	Embedded Computing in Engineering Design	1/3
ECE 2112	Electromagnetic Fields	1/3
ECE 2201	Microelectronic Circuits I	1/3
ECE 2305	Introduction to Communications and Networks	1/3
ECE 2311	Continuous-Time Signal and System Analysis	1/3
ECE 2312	Discrete-Time Signal and System Analysis	1/3
ECE 2799	Electrical and Computer Engineering Design	1/3
ECE 3012	Introduction to Control Systems Engineering	1/3
ECE 3113	Introduction to RF Circuit Design	1/3
ECE 3204	Microelectronic Circuits II	1/3
ECE 3308	Introduction to Wireless Networks	1/3
ECE 3311	Principles of Communication Systems	1/3
ECE 3500	Electric Power and Renewable Energy Systems	1/3
ECE 3501	Electromechanical Energy Systems	1/3
ECE 3829	Advanced Digital System Design with FPGAs	1/3
ECE 3849	Real-Time Embedded Systems	1/3
ECE 4305	Software-Defined Radio Systems and Analysis	1/3
ECE 4503	Power Electronics And Power Management	1/3
ECE 4703	Real-Time Digital Signal Processing	1/3
ECE 4801	Computer Organization and Design	1/3
ECE 4902	Analog Integrated Circuit Design	1/3
ECE 4904	Semiconductor Devices	1/3

2000+ Level Engineering Science Interdisciplinary Courses

Item #	Title	Units
ES 2001	Introduction to Materials Science	1/3
ES 2501	Introduction to Static Systems	1/3
ES 2502	Stress Analysis	1/3
ES 2503	Introduction to Dynamic Systems	1/3
ES 2800	Environmental Impacts of Engineering Decisions	1/3
ES 3001	Introduction to Thermodynamics	1/3
ES 3002	Mass Transfer	1/3
ES 3003	Heat Transfer	1/3
ES 3004	Fluid Mechanics	1/3
ES 3011	Control Engineering I	1/3
ES 3323	Advanced Computer Aided Design	1/3
ES 3501	A Project-Based Introduction to Systems Engineering	1/3

2000+ Level Mechanical Engineering Courses

Item #	Title	Units
BME 4504/ME 4504	Biomechanics	1/3
BME 4606/ME 4606	Biofluids	1/3
BME 4814/ME 4814	Biomaterials	1/3
ME 2300	Introduction to Engineering Design	1/3
ME 2312	Introduction to Computational Solutions for Engineering Problems	1/3
ME 2820	Materials Processing	1/3
ME 3310	Kinematics of Mechanisms	1/3
ME 3311	Dynamics of Mechanisms and Machines	1/3
ME 3320	Design of Machine Elements	1/3
ME 3411	Intermediate Fluid Mechanics	1/3
ME 3501	Elementary Continuum Mechanics	1/3
ME 3506	Rehabilitation Engineering	1/3
ME 3820	Computer-Aided Manufacturing	1/3
ME 3901	Engineering Experimentation	1/3
ME 3902	Project-Based Engineering Experimentation	1/3
ME 4320	Advanced Engineering Design	1/3
ME 4323	Fundamentals of Drivetrain Systems	1/3
ME 4324	Integrated Design of Mechanical Systems	1/3
ME 4422	Design and Optimization of Thermal Systems	1/3
ME 4424	Radiation Heat Transfer Application and Design	1/3
ME 4429	Thermofluid Application and Design	1/3
ME 4430	Integrated Thermomechanical Design and Analysis	1/3
ME 4505	Advanced Dynamics	1/3
ME 4506	Mechanical Vibrations	1/3
ME 4512	Introduction to the Finite Element Method	1/3
ME 4710	Gas Turbines for Propulsion and Power Generation	1/3
ME 4813	Ceramics and Glasses for Engineering Applications	1/3
ME 4821	Plastics	1/3
ME 4832	Corrosion and Corrosion Control	1/3
ME 4840	Physical Metallurgy	1/3
ME 4875/MTE 575	Introduction to Nanomaterials and Nanotechnology	1/3
RBE 4322/ME 4322	Modeling and Analysis of Mechatronic Systems	1/3

2000+ Level Robotics Engineering Courses (Excluding RBE 3100)

Item #	Title	Units
RBE 2001	Unified Robotics I: Actuation	1/3
RBE 2002	Unified Robotics II: Sensing	1/3
RBE 3001	Unified Robotics III: Manipulation	1/3
RBE 3002	Unified Robotics IV: Navigation	1/3
RBE 3100	Social Implications of Robotics	1/3
RBE 4322/ME 4322	Modeling and Analysis of Mechatronic Systems	1/3
RBE 4540	Vision-based Robotic Manipulation	1/3
RBE 4815	Industrial Robotics	1/3

B. 2/3 unit of 3000+ level in Engineering

3000+ Level Biomedical Engineering Courses

Item #	Title	Units
BME 3012	Biomedical Sensors Laboratory	1/6
BME 3013	Biomedical Instrumentation Laboratory	1/6
BME 3014	Physiological Signals Laboratory I: Techniques	1/6
BME 3111	Physiology and Engineering	1/3
BME 3112	Human Physiology for Biomedical Engineers	1/3
BME 3300	Biomedical Engineering Design	1/3
BME 3503	Skeletal Biomechanics Laboratory	1/6
BME 3505	Solid Biomechanics Laboratory: Techniques	1/6
BME 3506	Solid Biomechanics Laboratory: Applications	1/6
BME 3605	Biotransport Laboratory II: Applications	1/6
BME 3610	Transport Analysis in Bioengineering	1/3
BME 3811	Biomaterials Lab	1/6
BME 3813	Cellular Engineering Lab	1/6
BME 4011/ECE 4011	Biomedical Signal Analysis	1/3
BME 4023/ECE 4023	Biomedical Instrumentation Design	1/3
BME 4201	Biomedical Imaging	1/3
BME 4300	MQP Capstone Design	1/6
BME 4503	Computational Biomechanics	1/3
BME 4504/ME 4504	Biomechanics	1/3
BME 4606/ME 4606	Biofluids	1/3
BME 4701	Cell and Molecular Bioengineering	1/3
BME 4814/ME 4814	Biomaterials	1/3
BME 4828	Biomaterials-Tissue Interactions	1/3
BME 4831	Drug Delivery	1/3

3000+ Level Chemical Engineering Courses

Item #	Title	Units
CE 4063/CHE 4063	Transport & Transformations in the Environment	1/3
CHE 3201	Kinetics and Reactor Design	1/3
CHE 3301	Introduction to Biological Engineering	1/3
CHE 3501	Applied Mathematics in Chemical Engineering	1/3
CHE 3702	Energy Challenges in the 21st Century	1/3
CHE 3722	Bioenergy	1/3
CHE 4401	Unit Operations of Chemical Engineering I	1/3
CHE 4402	Unit Operations of Chemical Engineering II	1/3
CHE 4403	Chemical Engineering Design	1/3
CHE 4404	Chemical Plant Design Project	1/3
CHE 4405	Chemical Process Dynamics and Control Laboratory	1/3
CHE 4410	Chemical Process Safety Design	1/3

3000+ Level Civil and Environmental Engineering Courses (Excluding CE 3022)

Item #	Title	Units
CE 3006	Design of Steel Structures	1/3
CE 3008	Design of Reinforced Concrete Structures	1/3
CE 3010	Structural Engineering	1/3
CE 3020	Project Management	1/3
CE 3022	Legal Aspects of Professional Practice	1/3
CE 3025	Project Evaluation	1/3
CE 3026	Materials of Construction	1/3
CE 3030	Fundamentals of Civil Engineering Autocad	1/3
CE 3031	Building Information Modeling: Software Tools and Principles	1/3
CE 3041	Soil Mechanics	1/3
CE 3044	Foundation Engineering	1/3
CE 3050	Traffic Engineering	1/3
CE 3051	Pavement Engineering	1/3
CE 3059	Environmental Engineering	1/3
CE 3060	Water Treatment	1/3
CE 3061	Sustainable Wastewater Engineering: Treatment and Reuse	1/3
CE 3062	Hydraulics	1/3
CE 3070	Urban and Environmental Planning	1/3
CE 3074	Environmental Analysis	1/3
CE 4007	Matrix Analysis of Structures	1/3
CE 4060	Environmental Engineering Laboratory	1/3
CE 4061	Hydrology	1/3
CE 4063/CHE 4063	Transport & Transformations in the Environment	1/3
CE 4071	Land Use Development and Controls	1/3
CE 4600	Hazardous and Industrial Waste Management	1/3
CE 4610	Solid Waste Engineering	1/3

3000+ Level Electrical and Computer Engineering Courses

Item #	Title	Units
BME 4011/ECE 4011	Biomedical Signal Analysis	1/3
BME 4023/ECE 4023	Biomedical Instrumentation Design	1/3
CS 4801/ECE 4802	Introduction to Cryptography and Communication Security	1/3
ECE 3012	Introduction to Control Systems Engineering	1/3
ECE 3113	Introduction to RF Circuit Design	1/3
ECE 3204	Microelectronic Circuits II	1/3
ECE 3308	Introduction to Wireless Networks	1/3
ECE 3311	Principles of Communication Systems	1/3
ECE 3500	Electric Power and Renewable Energy Systems	1/3
ECE 3501	Electromechanical Energy Systems	1/3
ECE 3829	Advanced Digital System Design with FPGAs	1/3
ECE 3849	Real-Time Embedded Systems	1/3
ECE 4305	Software-Defined Radio Systems and Analysis	1/3
ECE 4503	Power Electronics And Power Management	1/3
ECE 4703	Real-Time Digital Signal Processing	1/3
ECE 4801	Computer Organization and Design	1/3
ECE 4902	Analog Integrated Circuit Design	1/3
ECE 4904	Semiconductor Devices	1/3

3000+ Level Engineering Science Interdisciplinary Courses

Item #	Title	Units
ES 3001	Introduction to Thermodynamics	1/3
ES 3002	Mass Transfer	1/3
ES 3003	Heat Transfer	1/3
ES 3004	Fluid Mechanics	1/3
ES 3011	Control Engineering I	1/3
ES 3323	Advanced Computer Aided Design	1/3
ES 3501	A Project-Based Introduction to Systems Engineering	1/3

3000+ Level Mechanical Engineering Courses

Item #	Title	Units
BME 4504/ME 4504	Biomechanics	1/3
BME 4606/ME 4606	Biofluids	1/3
BME 4814/ME 4814	Biomaterials	1/3
ME 3310	Kinematics of Mechanisms	1/3
ME 3311	Dynamics of Mechanisms and Machines	1/3
ME 3320	Design of Machine Elements	1/3
ME 3411	Intermediate Fluid Mechanics	1/3
ME 3501	Elementary Continuum Mechanics	1/3
ME 3506	Rehabilitation Engineering	1/3
ME 3820	Computer-Aided Manufacturing	1/3
ME 3901	Engineering Experimentation	1/3
ME 3902	Project-Based Engineering Experimentation	1/3
ME 4320	Advanced Engineering Design	1/3
ME 4323	Fundamentals of Drivetrain Systems	1/3
ME 4324	Integrated Design of Mechanical Systems	1/3
ME 4422	Design and Optimization of Thermal Systems	1/3
ME 4424	Radiation Heat Transfer Application and Design	1/3
ME 4429	Thermofluid Application and Design	1/3
ME 4430	Integrated Thermomechanical Design and Analysis	1/3
ME 4505	Advanced Dynamics	1/3
ME 4506	Mechanical Vibrations	1/3
ME 4512	Introduction to the Finite Element Method	1/3
ME 4710	Gas Turbines for Propulsion and Power Generation	1/3
ME 4813	Ceramics and Glasses for Engineering Applications	1/3
ME 4821	Plastics	1/3
ME 4832	Corrosion and Corrosion Control	1/3
ME 4840	Physical Metallurgy	1/3
ME 4875/MTE 575	Introduction to Nanomaterials and Nanotechnology	1/3
RBE 4322/ME 4322	Modeling and Analysis of Mechatronic Systems	1/3

3000+ Level Robotics Engineering Courses (Excluding RBE 3100)

Item #	Title	Units
RBE 3001	Unified Robotics III: Manipulation	1/3
RBE 3002	Unified Robotics IV: Navigation	1/3
RBE 3100	Social Implications of Robotics	1/3
RBE 4322/ME 4322	Modeling and Analysis of Mechatronic Systems	1/3
RBE 4540	Vision-based Robotic Manipulation	1/3
RBE 4815	Industrial Robotics	1/3

C. 9/3 units in Biomedical Engineering which must include the following:

i. 4/3 units of BME coursework at the 2000+ level

Item #	Title	Units
BME 2001	Introduction to Biomaterials	1/3
BME 2210	Biomedical Signals, Instruments and Measurements	1/3
BME 2211	Biomedical Data Analysis	1/3
BME 2502	Introduction to Biomechanics: Stress Analysis	1/3
BME 2610	Introduction to Bioprocess Engineering	1/3
BME 3012	Biomedical Sensors Laboratory	1/6
BME 3013	Biomedical Instrumentation Laboratory	1/6
BME 3014	Physiological Signals Laboratory I: Techniques	1/6
BME 3111	Physiology and Engineering	1/3
BME 3112	Human Physiology for Biomedical Engineers	1/3
BME 3300	Biomedical Engineering Design	1/3
BME 3503	Skeletal Biomechanics Laboratory	1/6
BME 3505	Solid Biomechanics Laboratory: Techniques	1/6
BME 3506	Solid Biomechanics Laboratory: Applications	1/6
BME 3605	Biotransport Laboratory II: Applications	1/6
BME 3610	Transport Analysis in Bioengineering	1/3
BME 3811	Biomaterials Lab	1/6
BME 3813	Cellular Engineering Lab	1/6
BME 4011/ECE 4011	Biomedical Signal Analysis	1/3
BME 4023/ECE 4023	Biomedical Instrumentation Design	1/3
BME 4201	Biomedical Imaging	1/3
BME 4300	MQP Capstone Design	1/6
BME 4503	Computational Biomechanics	1/3
BME 4504/ME 4504	Biomechanics	1/3
BME 4606/ME 4606	Biofluids	1/3
BME 4701	Cell and Molecular Bioengineering	1/3
BME 4814/ME 4814	Biomaterials	1/3
BME 4828	Biomaterials-Tissue Interactions	1/3
BME 4831	Drug Delivery	1/3

ii. 2/3 units of BME laboratories at the 3000+ level (four 1/6 unit labs)

Item #	Title	Units
BME 3012	Biomedical Sensors Laboratory	1/6
BME 3013	Biomedical Instrumentation Laboratory	1/6
BME 3014	Physiological Signals Laboratory I: Techniques	1/6
BME 3503	Skeletal Biomechanics Laboratory	1/6
BME 3505	Solid Biomechanics Laboratory: Techniques	1/6
BME 3506	Solid Biomechanics Laboratory: Applications	1/6
BME 3605	Biotransport Laboratory II: Applications	1/6
BME 3811	Biomaterials Lab	1/6
BME 3813	Cellular Engineering Lab	1/6

iii. 1/3 unit of BME design (BME 3300 or equivalent)

Item #	Title	Units
BME 3300	Biomedical Engineering Design	1/3

iv. 1/3 unit of BME coursework at the 4000 level

Item #	Title	Units
BME 4011/ECE 4011	Biomedical Signal Analysis	1/3
BME 4023/ECE 4023	Biomedical Instrumentation Design	1/3
BME 4201	Biomedical Imaging	1/3
BME 4300	MQP Capstone Design	1/6
BME 4503	Computational Biomechanics	1/3
BME 4504/ME 4504	Biomechanics	1/3
BME 4606/ME 4606	Biofluids	1/3
BME 4701	Cell and Molecular Bioengineering	1/3
BME 4814/ME 4814	Biomaterials	1/3
BME 4828	Biomaterials-Tissue Interactions	1/3
BME 4831	Drug Delivery	1/3

v. 1/3 unit of BME coursework at the 4000+ level

Item #	Title	Units
BME 4011/ECE 4011	Biomedical Signal Analysis	1/3
BME 4023/ECE 4023	Biomedical Instrumentation Design	1/3
BME 4201	Biomedical Imaging	1/3
BME 4300	MQP Capstone Design	1/6
BME 4503	Computational Biomechanics	1/3
BME 4504/ME 4504	Biomechanics	1/3
BME 4606/ME 4606	Biofluids	1/3
BME 4701	Cell and Molecular Bioengineering	1/3
BME 4814/ME 4814	Biomaterials	1/3
BME 4828	Biomaterials-Tissue Interactions	1/3
BME 4831	Drug Delivery	1/3

As part of the 14/3 units of engineering coursework, a subset of the courses must fulfill the following requirements:

For Requirements A-C above, you must take at least one course in each of the BME core competencies:

i. 1/3 unit of biomechanics or biofluids at the 2000+ level

Item #	Title	Units
BME 2502	Introduction to Biomechanics: Stress Analysis	1/3
BME 3610	Transport Analysis in Bioengineering	1/3
ES 2501	Introduction to Static Systems	1/3
ES 2502	Stress Analysis	1/3
ES 2503	Introduction to Dynamic Systems	1/3
ES 3004	Fluid Mechanics	1/3

ii. 1/3 unit of biomaterials or tissue engineering at the 2000+ level.

Item #	Title	Units
BME 2001	Introduction to Biomaterials	1/3
ES 2001	Introduction to Materials Science	1/3

iii. 1/3 unit of biosensors or bioinstrumentation at the 2000+ level

Item #	Title	Units
BME 2210	Biomedical Signals, Instruments and Measurements	1/3
ECE 2010	Introduction to Electrical and Computer Engineering	1/3

iv. 1/3 unit of experimental measurement and data analysis at the 2000+ level

Item #	Title	Units
BME 2211	Biomedical Data Analysis	1/3
ME 3901	Engineering Experimentation	1/3

For Requirement C above, a minimum of 1/6 unit must fulfill the living systems requirement.

Living Systems Requirement

Item #	Title	Units
BME 3012	Biomedical Sensors Laboratory	1/6
BME 3111	Physiology and Engineering	1/3
BME 3503	Skeletal Biomechanics Laboratory	1/6
BME 3813	Cellular Engineering Lab	1/6

Major Qualifying Project (3/3 units)

Must include a minimum of 1/3 unit Capstone Design Experience. Each Biomedical Engineering student must complete a Capstone Design experience requirement. The Capstone Design experience is partially or fully accomplished by completing the Major Qualifying Project which integrates the past course work and involves significant engineering design. At the time of registration for the MQP, the project advisor will determine whether the MQP will meet the full 1/3 unit Capstone Design requirement or not. If not, the advisor will identify an additional 1/6 unit of course work in the area of engineering design (BME 4300 or equivalent) to be taken in order to meet the ABET Capstone Design requirement.

Biomedical Engineering Specializations

Because BME is such a broad and diverse discipline, it is convenient to subdivide it into a number of different specializations, or tracks. At the undergraduate level, these specializations help to bring focus to course and project planning. At the graduate-level, these specializations are aligned with the research interests of our faculty. Here at WPI, three specializations have been defined: 1) Biomechanics, 2) Biomedical Instrumentation, Biosignals and Image Processing, and 3) Biomaterials and Tissue Engineering. If students are interested in developing an undergraduate program of study in one of these specializations, they should consult the Program of Study in BME sections of the catalog, within their chosen areas of specialization. See the department website for more details.

Biomechanics

Biomechanics is a specialization within biomedical engineering that involves the application of engineering mechanics to the study of biological tissues and physiological systems. When most people first think of biomechanics, the way we move or the strength of bones generally comes to mind. However, many other aspects are included in this diverse field of study including:

- Dynamics – e.g., analysis of human movement including walking, running, and throwing.
- Statics – e.g., determination of the magnitude and nature of forces in joints, bones, muscles and implanted prostheses, and characterization of the mechanical properties of the tissues in our bodies.
- Stress Analysis – e.g. calculation of the stresses and deformations within biological tissues and prostheses, and characterization of the mechanical properties of tissues and biomaterials.
- Fluid mechanics and transport – e.g., analysis flow of blood through arteries and air through the lung and diffusion of oxygen in tissues.
- Biomechanics research has improved our understanding of:
- Design and manufacturing of medical instruments, devices for disabled persons, artificial replacements, and implants.
- Human performance in the workplace and in athletic competition.
- Normal and pathological human and animal locomotion.
- The mechanical properties of hard and soft tissues.
- Neuromuscular control.
- The connection between blood flow and arteriosclerosis.
- Air flow and lung pathology.
- The effects of mechanical loads on cellular mechanics and physiology.
- Morphogenesis, growth, and healing.
- The mechanics of biomaterials.
- Engineering of living replacement tissue (tissue engineering)

Biomedical Instrumentation, Biosignals and Image Processing

Bioinstrumentation

Modern health care relies heavily on a large array of sophisticated medical instrumentation and sensors to diagnose health problems, to monitor patient condition and administer therapeutic treatments, most often in a non-invasive or minimally-invasive manner. During the past decade, computers have become an essential part of modern bioinstrumentation, from the microprocessor in a single-purpose wearable instrument used to achieve a variety of small tasks to more sophisticated desk-top instruments needed to process the large amount of clinical information acquired from patients. The Biomedical Instrumentation track of our program is focused on training students to design, test, and use sensors and biomedical instrumentation to further enhance the quality of health care. Emphasis is placed both on understanding the physiological systems involved in the generation of the measured variable or affected by therapeutic equipment, as well as the engineering principles of biomedical sensors and biomedical devices.

Examples of common biomedical instrumentations used routinely in medicine include:

- Specialized instrumentation for genetic testing.

- Electrocardiography to measure the electrical activity of the heart.
- Electroencephalography to measure the electrical activities of the brain.
- Electromyography to measure the electrical activities of muscles.
- Mechanical respirators.
- Cardiac pacemakers.
- Defibrillators.
- An artificial heart.
- Heart-lung machines.
- Pulse oximeters.
- Drug infusion and insulin pumps.
- Electrosurgical equipment.
- Anesthesia equipment.
- Kidney dialysis machines.
- Artificial electronic prosthetics used by disabled people (e.g. hearing aids).
- Laser systems for minimally invasive surgery.

Biosignals

Biosignal processing involves the collection and analysis of data from patients or experiments to identify and extract distinct components of the data set that may lead to better understanding of the processes involved in physiological regulation. For example, identifying and quantifying differences in the dynamic characteristics of physiological function between normal and diseased conditions utilizing biosignal processing techniques may lead to a better understanding of the role of regulatory imbalance in diseased conditions, and should have important clinical and diagnostic and prognostic application.

Examples of biosignal processing include:

- Detection of malignant heart rhythms from electrocardiograms.
- Early detection of sudden cardiac death.
- Monitoring of vital signs.
- Seizure detection using electroencephalogram recordings.
- Real-time control of artificial prosthetics.
- Real-time control of robotic movements.
- Early detection of hypertension and onset of diabetes.
- Wireless transmission of diagnostic devices.
- Modeling of pharmacokinetics and design of algorithms for robust drug delivery.
- Bioinformatics.
- Pattern recognition and decision support systems.
- Artificial intelligence.

Image Processing

Biomedical image processing involves the application of quantitative science and engineering to detect and visualize biological processes. An important area is the application of these tools to the study of diseases with an ultimate goal of aiding medical intervention. While x-ray imaging is an obvious and familiar example with tremendous diagnostic utility, it represents only a small aspect of this important field. Biomedical engineers are active participants in the development of new imaging modalities to acquire and process images from the body, most often in a non-invasive or minimally-invasive manner.

Examples of biomedical imaging and image processing include:

- X-ray imaging and computer-aided tomography (CAT).
- Visible light and optical imaging.
- Near-infrared imaging.
- Magnetic resonance imaging (MRI).
- Ultrasound imaging.
- Nuclear medicine imaging.
- Luminescence-based imaging.

Biomaterials

Biomaterials is a specialization within biomedical engineering that integrates engineering fundamentals in materials science with principles of cell biology, chemistry and physiology to aid in the design and development of materials used in the production of medical devices. When most people first think of biomaterials, implants such as surgical sutures, artificial hips or pacemakers generally come to mind, but many other aspects are included in this diverse field of study:

- Biomaterials Design – Identify the physiological and engineering criteria that an implantable biomaterial must meet. Select the proper chemical composition to insure that the biomaterial imparts the desired mechanical properties and evokes the appropriate tissue response for the specified application.
- Mechanics of Biomaterials – Characterize the magnitude and nature of the mechanical properties of biomaterials. Predict and measure how the physical/structural properties of a biomaterial determine its mechanical properties.
- Biomaterials-Tissue Interactions – Examine the molecular, cellular and tissue responses to implanted medical devices. Design biomaterials with properties that induce the desired wound healing and tissue remodeling responses from the body.
- Biomaterials research and development has improved our health care in many ways including:
- Design and manufacture of replacements parts for damaged or diseased tissues and organs (e.g., artificial hip joints, kidney dialysis machines)
- Improved wound healing (e.g., sutures, wound dressings)
- Enhanced performance of medical devices (e.g., contact lenses, pacemakers)
- Correct functional abnormalities (e.g., spinal rods)
- Correct cosmetic problems (e.g., reconstructive mammoplasty, chin augmentation)
- Aid in clinical diagnostics (e.g., probes and catheters)
- Aid in clinical treatments (e.g., cardiac stents, drains and catheters)
- Design biodegradable scaffolds for tissue engineering (e.g., dermal analogs)

Tissue Engineering

Tissue engineering integrates the principles and methods of engineering with the fundamentals of life sciences towards the development of biological substitutes to restore, maintain or improve tissue/organ function. When most people first think of tissue engineering, artificial skin and cartilage generally comes to mind, but many other aspects are included in this diverse field of study:

- Scaffold/Biomaterial Design – Identify the physiological and engineering criteria that a biodegradable scaffold must meet. Select the proper biochemical composition to insure that the cells perform in a physiologic manner on the surface of the scaffold.
- Functional/Biomechanical Tissue Engineering – Characterize the roles of biomechanical and biochemical stimuli on the formation, growth, development and function of bioengineered cells, tissues and organs. Create accurate biomimetic engineered tissue models of human disease to aid in the discovery, invention and development of novel therapeutic strategies.
- Bioreactor Design – Design reactors that control the rates at which nutrients and growth factors are supplied to bioengineered tissues and organs during growth and development in a laboratory environment.

Program Chart and/or Course Flow Chart

BIOMEDICAL ENGINEERING PROGRAM CHART

1/3 UNIT

BASIC SCIENCE AND MATHEMATICS	
Mathematics (MA): 6/3 units, including differential equations and statistics	
Biology (BB): 2/3 units	Physics (PH): 2/3 units
Chemistry (CH): 2/3 units	Supplemental Science: 1/3 unit

1/3 UNIT

PHYSIOLOGY
1/3 unit Physiology

1/3 UNIT

COMPUTER PROGRAMMING
1/3 unit Computer Programming/Logic

9/3 UNITS

BIOMEDICAL ENGINEERING*,a

4/3 units BME at ≥ 2000-level

2/3 units BME laboratories at ≥ 3000-level (four 1/6-unit labs)
1/3 unit Design
1/3 unit at 4000-level
1/3 unit at ≥ 4000-level

At least 1/6 unit must fulfill the living systems laboratory requirement†

* 1000-level courses do not satisfy requirements
† BME 3111, BME 3012, BME 3503, or BME 3813
BME3111 can count towards 4/3 units BME at ≥ 2000-level or the physiology requirement above, but cannot double-count towards both

5/3 UNITS

ENGINEERING [a]
Engineering: 3/3 units at ≥ 2000-level
Engineering: 2/3 units at ≥ 3000-level

2 UNITS

HUMANITIES
See undergraduate catalog

2/3 UNIT

SOCIAL SCIENCE
See undergraduate catalog

1 UNIT

IQP
See undergraduate catalog

1 UNIT

MQP
See undergraduate catalog Must include a minimum of 1/3 unit Capstone Design

1/3 UNIT

FREE ELECTIVE
See undergraduate catalog

1/3 UNIT

PHYSICAL EDUCATION
See undergraduate catalog

BME CORE KNOWLEDGE/BREADTH AREAS

[a] **At least one course must be selected from each of the areas below (part of the 14/3 units):**

Biomechanics/ Biofluids	Biomaterials/Tissue Engineering	Bioinstrumentation /Biosensors	Measurement and Data Analysis
BME 2502	BME 2001	BME 2210	BME 2211
BME 3610			
ES 2501	ES 2001	ECE 2010	ME 3901
ES 2502			
ES 2503			
ES 3004			

The course designation determines if the selected course counts towards the 9/3 units BME requirement or the 5/3 units other Engineering requirement

Chemical Engineering

S. ROBERTS, HEAD

PROFESSORS: T. A. Camesano, N.A. Deskins, D. DiBiasio, R. Datta, A. G. Dixon, N. K. Kazantzis, S. Roberts, X. Teng, M. T. Timko, H. Zhou

ASSOCIATE PROFESSORS: A. Teixeira

ASSISTANT PROFESSORS: C. Bailey-Hytholt, E. Stewart, E. Young

ASSISTANT PROFESSOR OF TEACHING (TENURE TRACK): L. Abu-Lail

PROFESSOR OF PRACTICE: S. J. Kmiotek

ASSOCIATE TEACHING PROFESSOR: W. Zurawsky

ASSISTANT RESEARCH PROFESSORS: A. Maag, A. Panahi, G. Tompsett

ASSOCIATED FACULTY: J. Bergendahl (CEE), J. Coburn (BME), N. Dempsey (FPE), R. Grimm (CBC), D. Lados (ME), J. Liang (ME), G. Pins (BME), P. Rao (ME), R. Rao (BBT), A. Rangwala (FPE), K. Rashid, L. Titova (PH), Y. Wang (ME)

EMERITUS FACULTY: W. M. Clark, Y. H. Ma, W. R. Moser, R. W. Thompson, A.H. Weiss

Mission Statement

To prepare technically advanced, socially aware and interdisciplinary-minded chemical engineers. Our graduates will be ready to serve the global community as leaders, scholars and innovators.

Vision Statement

WPI's chemical engineering department will be a national leader in innovating and implementing curricula, project work and research that infuses global, entrepreneurial and humanitarian perspectives.

Program Educational Objectives

The Chemical Engineering Department has established the following objectives of the undergraduate program in support of our mission and that of the Institute. Graduates are expected to be able to attain these objectives within 5 years following graduation:

1. Graduates will be able to use chemical engineering principles to solve problems of practical importance to society.
2. Graduates will be productive and informed citizens of society as well as of their professional community and will be positioned for a lifetime of success.
3. Graduates will be effective communicators.

Student Outcomes

In support of the three Program Educational Objectives, the

Chemical Engineering Department has adopted the eleven

Student Outcomes established in ABET Criteria 3, (1)-(7),

listed below:

Students shall demonstrate:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. an ability to communicate effectively with a range of audiences

4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

NOTE: Courses listed in previous catalogs with “CM” as the prefix and the same course number as below are considered to be the SAME COURSE .

Chemical Engineering Major

Degree Type
Bachelor of Science

The normal period of residency at WPI is 16 terms. In addition to the WPI requirements applicable to all students, students wishing to receive the ABET-accredited degree designated “Chemical Engineering” must satisfy the distribution requirements shown below.

Program Distribution Requirements for the Chemical Engineering Major

Mathematics and Base Science (Minimum 12/3 Units)

Must include differential and integral calculus and differential equations. Must include 3 courses in chemistry, 2 courses in physics and 1 course in biology or biochemistry.

Chemistry Courses

Item #	Title	Units
BB 4170/CH 4170	Experimental Genetic Engineering	1/3
BB 4190/CH 4190	Regulation of Gene Expression	1/3
CH 1010	Chemical Properties, Bonding, and Forces	1/3
CH 1020	Chemical Reactions	1/3
CH 1030	Kinetics, Equilibrium and Thermodynamics	1/3
CH 1040	Spectroscopy in Organic and Polymer Chemistry	1/3
CH 2310	Organic Chemistry I	1/3
CH 2320	Organic Chemistry II	1/3
CH 2330	Organic Chemistry III	1/3
CH 2360	Organic Laboratory	1/3
CH 2640	Experimental Chemistry I: Instrumental Analysis	1/3
CH 2650	Modern Physical Chemistry Methods	1/3
CH 2660	Organic Synthesis and Analysis Laboratory	1/3
CH 2670	Investigation of Coordination Complexes Through Inquiry	1/3
CH 3310	Advanced Organic Chemistry	1/3
CH 3410	Structure, Bonding, and Reactivity in Inorganic Chemistry	1/3
CH 3510	Chemical Thermodynamics	1/3
CH 3530	Quantum Chemistry	1/3
CH 3550	Chemical Dynamics	1/3
CH 4110	Protein Structure and Function	1/3
CH 4120	Lipids and Biomembrane Functions	1/3
CH 4130	Nucleic Acids and Bioinformation	1/3
CH 4140	Metabolism and Disease	1/3
CH 4150	Enzymology and Protein Characterization Laboratory	1/3
CH 4160	Membrane Biophysics	1/3
CH 4330	Organic Synthesis	1/3
CH 4420	Principles and Applications of Group Theory in Chemistry	1/3
CH 4520	Chemical Statistical Mechanics	1/3

Physics Courses

Item #	Title	Units
PH 1110	General Physics—Mechanics	1/3
PH 1111	Principles of Physics—Mechanics	1/3
PH 1120	General Physics—Electricity and Magnetism	1/3
PH 1121	Principles of Physics—Electricity and Magnetism	1/3
PH 1130	Modern Physics	1/3
PH 1140	Oscillations and Waves	1/3
PH 1150	Introductory Physics of Living Systems	1/3
PH 2101	Principles of Thermodynamics	1/3
PH 2201	Intermediate Mechanics I	1/3
PH 2202	Intermediate Mechanics II	1/3
PH 2301	Electromagnetic Fields	1/3
PH 2501	Photonics	1/3
PH 2502	Lasers	1/3
PH 2510	Atomic Force Microscopy	1/3
PH 2520	Introduction to Astrophysics	1/3
PH 2540	Solar Systems	1/3
PH 2550/AE 2550	Atmospheric and Space Environments	1/3
PH 2601	Photonics Laboratory	1/3
PH 2651	Intermediate Physics Laboratory	1/3
PH 3206	Statistical Physics	1/3
PH 3301	Electromagnetic Theory	1/3
PH 3401	Quantum Mechanics I	1/3
PH 3402	Quantum Mechanics II	1/3
PH 3501	Relativity	1/3
PH 3502	Solid State Physics	1/3
PH 3503	Nuclear Physics	1/3
PH 3504	Optics	1/3
PH 4201/PH 511	Advanced Classical Mechanics	1/3

Biology or Biochemistry Courses

Item #	Title	Units
BB 1001	Introduction to Biology	1/3
BB 1002	Environmental Biology	1/3
BB 1003/BCB 1003	Exploring Bioinformatics and Computational Biology	1/3
BB 1025	Human Biology	1/3
BB 1035	Biotechnology	1/3
BB 1045	Biodiversity	1/3
BB 2002	Microbiology	1/3
BB 2003	Fundamentals of Microbiology	1/3
BB 2030	Plant Diversity	1/3
BB 2040	Principles of Ecology	1/3
BB 2050	Animal Behavior	1/3
BB 2550	Cell Biology	1/3
BB 2902	Enzymes, Proteins, and Purification	1/6
BB 2903	Anatomy and Physiology	1/6
BB 2904	Ecology, Environment, and Animal Behavior	1/6
BB 2915	Searching for Solutions in Soil: Microbial and Molecular Investigations	1/3
BB 2917	Hunting for Phage	1/3
BB 2920	Genetics	1/3
BB 2950	Molecular Biology	1/3
BB 3003	Medical Microbiology: Plagues of the Modern World, a Case Study Approach	1/3
BB 3010/BCB 3010	Simulation in Biology	1/3
BB 3050	Cancer Biology	1/3
BB 3080	Neurobiology	1/3
BB 3101	Human Anatomy & Physiology: Movement and Communication	1/3
BB 3102	Human Anatomy & Physiology: Transport and Maintenance	1/3
BB 3120	Plant Physiology	1/3
BB 3140	Evolution: Pattern and Process	1/3
BB 3512	Molecular Genetics Lab	1/6
BB 3513	Cell Culture Techniques for Animal Cells	1/6
BB 3515	Physiologic Systems Laboratory	1/3
BB 3517	Fermentation	1/6
BB 3519	Protein Purification	1/6
BB 3521	Microscopy	1/6
BB 3525	Plant Physiology	1/6
BB 3526	Phage Hunters: the Analysis	1/6
BB 3527	Molecular Biology and Genetic Engineering: Approaches and Applications	1/3
BB 3530	Immunotherapies: The Next Generation of Pharmaceuticals	1/3
BB 3570	Cell Culture Models for Tissue Regeneration	1/3
BB 3620	Developmental Biology	1/3
BB 3920	Immunology	1/3
BB 4150	Environmental Change: Problems and Approaches	1/3
BB 4170/CH 4170	Experimental Genetic Engineering	1/3
BB 4190/CH 4190	Regulation of Gene Expression	1/3
BB 4260	Synthetic Biology	1/3
BB 4801/BCB 4001	Bioinformatics	1/3
BB 4900	Capstone Experience in Biology and Biotechnology	1/3

Engineering Science and Design (Minimum 18/3 Units)

Must include 3/3 unit of MQP, 1/3 unit of capstone design experience (e.g. CHE 4404 or CHE 4410), and at least 1/3 unit of engineering study outside the major. Courses used to satisfy this requirement must be at the 2000 level or above, with the exception of CHE 1011. Students may not count both CHE 1011 and ES 2002 as engineering electives. CS and DS courses are included in the category of engineering study.

Core Chemical Engineering Courses (Minimum 12/3 Units)

Item #	Title	Units
CHE 2011	Chemical Engineering Fundamentals	1/3
CHE 2012	Elementary Chemical Processes	1/3
CHE 2013	Applied Chemical Engineering Thermodynamics	1/3
CHE 2014	Advanced Chemical Processes	1/3
CHE 3201	Kinetics and Reactor Design	1/3
CHE 3501	Applied Mathematics in Chemical Engineering	1/3
CHE 4401	Unit Operations of Chemical Engineering I	1/3
CHE 4402	Unit Operations of Chemical Engineering II	1/3
CHE 4403	Chemical Engineering Design	1/3
CHE 4404	Chemical Plant Design Project	1/3
CHE 4405	Chemical Process Dynamics and Control Laboratory	1/3
CHE 4410	Chemical Process Safety Design	1/3
ES 3002	Mass Transfer	1/3
ES 3003	Heat Transfer	1/3
ES 3004	Fluid Mechanics	1/3

Must include at least 4 units from the above list of core chemical engineering courses. Students may not count both CHE 4404 and CHE 4410 as core courses.

Advanced Chemistry and Natural Science (Minimum 5/3 Units)

Any 2000 level and above BB, CH, PH, or GE courses and CH 1040. Must include 3 advanced CH courses at 2000 level or above which does not include CH 1040. Up to 2/3 unit of Advanced Chemistry and Natural Science may be double counted under both Advanced Chemistry and Basic Science.

2000+ Level Chemistry and Biochemistry (CH) Courses

Item #	Title	Units
BB 4170/CH 4170	Experimental Genetic Engineering	1/3
BB 4190/CH 4190	Regulation of Gene Expression	1/3
CH 2310	Organic Chemistry I	1/3
CH 2320	Organic Chemistry II	1/3
CH 2330	Organic Chemistry III	1/3
CH 2360	Organic Laboratory	1/3
CH 2640	Experimental Chemistry I: Instrumental Analysis	1/3
CH 2650	Modern Physical Chemistry Methods	1/3
CH 2660	Organic Synthesis and Analysis Laboratory	1/3
CH 2670	Investigation of Coordination Complexes Through Inquiry	1/3
CH 3310	Advanced Organic Chemistry	1/3
CH 3410	Structure, Bonding, and Reactivity in Inorganic Chemistry	1/3
CH 3510	Chemical Thermodynamics	1/3
CH 3530	Quantum Chemistry	1/3
CH 3550	Chemical Dynamics	1/3
CH 4110	Protein Structure and Function	1/3
CH 4120	Lipids and Biomembrane Functions	1/3
CH 4130	Nucleic Acids and Bioinformation	1/3
CH 4140	Metabolism and Disease	1/3
CH 4150	Enzymology and Protein Characterization Laboratory	1/3
CH 4160	Membrane Biophysics	1/3
CH 4330	Organic Synthesis	1/3
CH 4420	Principles and Applications of Group Theory in Chemistry	1/3
CH 4520	Chemical Statistical Mechanics	1/3

CH 1040: Spectroscopy in Organic and Polymer Chemistry

Item #	Title	Units
CH 1040	Spectroscopy in Organic and Polymer Chemistry	1/3

2000+ Level Biology and Biotechnology (BB) Courses

Item #	Title	Units
BB 2002	Microbiology	1/3
BB 2003	Fundamentals of Microbiology	1/3
BB 2030	Plant Diversity	1/3
BB 2040	Principles of Ecology	1/3
BB 2050	Animal Behavior	1/3
BB 2550	Cell Biology	1/3
BB 2902	Enzymes, Proteins, and Purification	1/6
BB 2903	Anatomy and Physiology	1/6
BB 2904	Ecology, Environment, and Animal Behavior	1/6
BB 2915	Searching for Solutions in Soil: Microbial and Molecular Investigations	1/3
BB 2917	Hunting for Phage	1/3
BB 2920	Genetics	1/3
BB 2950	Molecular Biology	1/3
BB 3003	Medical Microbiology: Plagues of the Modern World, a Case Study Approach	1/3
BB 3010/BCB 3010	Simulation in Biology	1/3
BB 3050	Cancer Biology	1/3
BB 3080	Neurobiology	1/3
BB 3101	Human Anatomy & Physiology: Movement and Communication	1/3
BB 3102	Human Anatomy & Physiology: Transport and Maintenance	1/3
BB 3120	Plant Physiology	1/3
BB 3140	Evolution: Pattern and Process	1/3
BB 3512	Molecular Genetics Lab	1/6
BB 3513	Cell Culture Techniques for Animal Cells	1/6
BB 3515	Physiologic Systems Laboratory	1/3
BB 3517	Fermentation	1/6
BB 3519	Protein Purification	1/6
BB 3521	Microscopy	1/6
BB 3525	Plant Physiology	1/6
BB 3526	Phage Hunters: the Analysis	1/6
BB 3527	Molecular Biology and Genetic Engineering: Approaches and Applications	1/3
BB 3530	Immunotherapies: The Next Generation of Pharmaceuticals	1/3
BB 3570	Cell Culture Models for Tissue Regeneration	1/3
BB 3620	Developmental Biology	1/3
BB 3920	Immunology	1/3
BB 4150	Environmental Change: Problems and Approaches	1/3
BB 4170/CH 4170	Experimental Genetic Engineering	1/3
BB 4190/CH 4190	Regulation of Gene Expression	1/3
BB 4260	Synthetic Biology	1/3
BB 4801/BCB 4001	Bioinformatics	1/3
BB 4900	Capstone Experience in Biology and Biotechnology	1/3

2000+ Level Physics (PH) Courses

Item #	Title	Units
PH 2101	Principles of Thermodynamics	1/3
PH 2201	Intermediate Mechanics I	1/3
PH 2202	Intermediate Mechanics II	1/3
PH 2301	Electromagnetic Fields	1/3
PH 2501	Photonics	1/3
PH 2502	Lasers	1/3
PH 2510	Atomic Force Microscopy	1/3
PH 2520	Introduction to Astrophysics	1/3
PH 2540	Solar Systems	1/3
PH 2550/AE 2550	Atmospheric and Space Environments	1/3
PH 2601	Photonics Laboratory	1/3
PH 2651	Intermediate Physics Laboratory	1/3
PH 3206	Statistical Physics	1/3
PH 3301	Electromagnetic Theory	1/3
PH 3401	Quantum Mechanics I	1/3
PH 3402	Quantum Mechanics II	1/3
PH 3501	Relativity	1/3
PH 3502	Solid State Physics	1/3
PH 3503	Nuclear Physics	1/3
PH 3504	Optics	1/3
PH 4201/PH 511	Advanced Classical Mechanics	1/3

2000+ Level Geosciences (GE) Courses

Item #	Title	Units
GE 2341	Geology	1/3

Concentrations for Chemical Engineering Majors

Chemical engineering majors may choose to focus their studies by obtaining one of the following Concentrations: Biological, Energy, Environmental, or Materials. A Concentration is not mandatory and some students will benefit from exploring a variety of areas rather than choosing to focus on one. The Concentrations require 3 units of study (potentially all of which may be double-counted towards the Chemical Engineering degree) comprised of the following: an MQP (that satisfies the Chemical Engineering degree requirement and covers a topic in the Concentration field) and 2 units from the appropriate list below. We have designed each concentration around a fundamental course offered annually in the Department (shown in bold for each concentration below) that students are encouraged to take. Students should consult their academic advisor for advice and the Chemical Engineering Department Undergraduate Committee for approval of an appropriate course of study. Appropriate experimental courses, ISUs, and other appropriate courses or projects, not on the current lists, may be applied towards a Concentration with approval from the Chemical Engineering Undergraduate Committee.

Chemical Engineering Major with Biological Concentration

Degree Type

Concentration

Chemical engineering majors may choose to focus their studies on a Biological Concentration. A Concentration is not mandatory and some students will benefit from exploring a variety of areas rather than choosing to focus on one.

The Concentrations require 3 units of study (potentially all of which may be double-counted towards the Chemical Engineering degree) comprised of the following:

- An MQP (that satisfies the Chemical Engineering degree requirement and covers a topic in the Concentration field) and
- 6/3 units from the list below.

We have designed each concentration around a fundamental course offered annually in the Department (indicated below) that students are encouraged to take. Students should consult their academic advisor for advice and the Chemical Engineering Department Undergraduate Committee for approval of an appropriate course of study. Appropriate experimental courses, ISUs, and other appropriate courses or projects, not on the current lists, may be applied towards a Concentration with approval from the Chemical Engineering Undergraduate Committee.

Program Distribution Requirements for the Chemical Engineering Major with Biological Concentration

Biological Concentration Courses (Minimum 6/3 Units)

Fundamental:

Item #	Title	Units
CHE 3301	Introduction to Biological Engineering	1/3

Science:

Item #	Title	Units
BB 1025	Human Biology	1/3
BB 1035	Biotechnology	1/3
BB 2003	Fundamentals of Microbiology	1/3
BB 2550	Cell Biology	1/3
BB 3102	Human Anatomy & Physiology: Transport and Maintenance	1/3
CH 4110	Protein Structure and Function	1/3
CH 4120	Lipids and Biomembrane Functions	1/3
CH 4130	Nucleic Acids and Bioinformation	1/3

Engineering Science and Design:

Item #	Title	Units
BME 1001	Introduction to Biomedical Engineering	1/3
BME 4504/ME 4504	Biomechanics	1/3
BME 4606/ME 4606	Biofluids	1/3
BME 4814/ME 4814	Biomaterials	1/3
CHE 3201	Kinetics and Reactor Design	1/3
CHE 4402	Unit Operations of Chemical Engineering II	1/3

*No more than one 1000-level course may be counted.

Major Qualifying Project (MQP) (Minimum 3/3 Units)

MQP must satisfy the Chemical Engineering degree requirement and cover a topic in the Biological field.

Chemical Engineering Major with Concentration in Energy

Degree Type

Concentration

Chemical engineering majors may choose to focus their studies on an Energy Concentration. A Concentration is not mandatory and some students will benefit from exploring a variety of areas rather than choosing to focus on one.

The Concentrations require 3 units of study (potentially all of which may be double-counted towards the Chemical Engineering degree) comprised of the following:

- An MQP (that satisfies the Chemical Engineering degree requirement and covers a topic in the Concentration field) and
- 6/3 units from the list below.

Students should consult their academic advisor for advice and the Chemical Engineering Department Undergraduate Committee for approval of an appropriate course of study. Appropriate experimental courses, ISUs, and other appropriate courses or projects, not on the current lists, may be applied towards a Concentration with approval from the Chemical Engineering Undergraduate Committee.

Program Distribution Requirements for the Chemical Engineering Major with Energy Concentration

Energy Concentration Courses (Minimum 6/3 Units)

Science:

Item #	Title	Units
CH 3510	Chemical Thermodynamics	1/3
CH 3550	Chemical Dynamics	1/3
PH 2101	Principles of Thermodynamics	1/3

Engineering Science and Design:

Item #	Title	Units
CHE 3201	Kinetics and Reactor Design	1/3
CHE 3301	Introduction to Biological Engineering	1/3
CHE 3702	Energy Challenges in the 21st Century	1/3
CHE 3722	Bioenergy	1/3
CHE 4402	Unit Operations of Chemical Engineering II	1/3
ES 3001	Introduction to Thermodynamics	1/3
ES 3003	Heat Transfer	1/3
ME 4710	Gas Turbines for Propulsion and Power Generation	1/3

***Note:** Only one of the following courses may be counted: ES 3001, CH 3510, or PH 2101.

Major Qualifying Project (MQP) (Minimum 3/3 Units)

MQP must satisfy the Chemical Engineering degree requirement and cover a topic in the Energy field.

Chemical Engineering Major with Concentration in Materials

Degree Type

Concentration

Chemical engineering majors may choose to focus their studies on a Materials Concentration. A Concentration is not mandatory and some students will benefit from exploring a variety of areas rather than choosing to focus on one.

The Concentrations require 3 units of study (potentially all of which may be double-counted towards the Chemical Engineering degree) comprised of the following:

- An MQP (that satisfies the Chemical Engineering degree requirement and covers a topic in the Concentration field) and
- 6/3 units from the list below.

We have designed each concentration around a fundamental course offered annually in the Department (indicated below) that students are encouraged to take. Students should consult their academic advisor for advice and the Chemical Engineering Department Undergraduate Committee for approval of an appropriate course of study. Appropriate experimental courses, ISUs, and other appropriate courses or projects, not on the current lists, may be applied towards a Concentration with approval from the Chemical Engineering Undergraduate Committee.

Program Distribution Requirements for the Chemical Engineering Major with Materials Concentration

Materials Concentration Courses (Minimum 6/3 Units)

Fundamental:

Item #	Title	Units
ES 2001	Introduction to Materials Science	1/3

Science:

Item #	Title	Units
CH 2320	Organic Chemistry II	1/3
CH 3410	Structure, Bonding, and Reactivity in Inorganic Chemistry	1/3
CH 4330	Organic Synthesis	1/3

Engineering Science and Design:

Item #	Title	Units
BME 4814/ME 4814	Biomaterials	1/3
CHE 3201	Kinetics and Reactor Design	1/3
ME 2820	Materials Processing	1/3
ME 4813	Ceramics and Glasses for Engineering Applications	1/3
ME 4821	Plastics	1/3
ME 4832	Corrosion and Corrosion Control	1/3
ME 4840	Physical Metallurgy	1/3
ME 4875/MTE 575	Introduction to Nanomaterials and Nanotechnology	1/3

Major Qualifying Project (MQP) (Minimum 6/3 Units)

MQP must satisfy the Chemical Engineering degree requirement and cover a topic in the Materials field.

Chemical Engineering Major with Environmental Concentration

Degree Type
Concentration

Chemical engineering majors may choose to focus their studies on an Environmental Concentration. A Concentration is not mandatory and some students will benefit from exploring a variety of areas rather than choosing to focus on one.

The Concentrations require 3 units of study (potentially all of which may be double-counted towards the Chemical Engineering degree) comprised of the following:

- An MQP (that satisfies the Chemical Engineering degree requirement and covers a topic in the Concentration field) and
- 6/3 units from the list below.

We have designed each concentration around a fundamental course offered annually in the Department (indicated below) that students are encouraged to take. Students should consult their academic advisor for advice and the Chemical Engineering Department Undergraduate Committee for approval of an appropriate course of study. Appropriate experimental courses, ISUs, and other appropriate courses or projects, not on the current lists, may be applied towards a Concentration with approval from the Chemical Engineering Undergraduate Committee.

Program Distribution Requirements for the Chemical Engineering Major with Environmental Concentration

Environmental Concentration Courses (Minimum 6/3 Units)

Fundamental:

Item #	Title	Units
CE 4063/CHE 4063	Transport & Transformations in the Environment	1/3

Science:

Item #	Title	Units
BB 1002	Environmental Biology	1/3
BB 2040	Principles of Ecology	1/3
GE 2341	Geology	1/3

Engineering Science and Design:

Item #	Title	Units
CE 3059	Environmental Engineering	1/3
CE 3060	Water Treatment	1/3
CE 3061	Sustainable Wastewater Engineering: Treatment and Reuse	1/3
CE 3070	Urban and Environmental Planning	1/3
CE 3074	Environmental Analysis	1/3
CE 4060	Environmental Engineering Laboratory	1/3
CE 4061	Hydrology	1/3
CHE 3201	Kinetics and Reactor Design	1/3
CHE 3301	Introduction to Biological Engineering	1/3
CHE 4402	Unit Operations of Chemical Engineering II	1/3
ES 2800	Environmental Impacts of Engineering Decisions	1/3
ES 3002	Mass Transfer	1/3

***Note:** Only one of the following courses may be counted: CE 3059, CE 3070, or CE 3074.

Major Qualifying Project (MQP) (Minimum 3/3 Units)

MQP must satisfy the Chemical Engineering degree requirement and cover a topic in the Environmental field.

Civil, Environmental & Architectural Engineering

C. M. EGGLESTON, HEAD; M. TAO, ASSOCIATE HEAD

PROFESSORS: C. M. Eggleston, T. El-Korchi, N. Rahbar, H. W. Walker

ASSOCIATE PROFESSORS: L. D. Albano, J. A. Bergendahl, J. D. Dudle

P. P. Mathisen, A. R. Sakulich, M. Tao, S. Van Dessel

ASSISTANT PROFESSORS: S. Liu, N. Ma

ASSOCIATE PROFESSORS OF TEACHING: D. Rosbach

ASSISTANT PROFESSORS OF TEACHING: L. Abu-Lail, S. Farzin

ASSISTANT TEACHING PROFESSORS: J. A. Rosewitz

SENIOR INSTRUCTORS: S. LePage

EMERITUS PROFESSORS: R. Fitzgerald, J. C. O'Shaughnessy, R. Pietroforte. G. Salazar

ASSOCIATED FACULTY: T. Camesano (CHE), S. Kmiotek (CHE)

Mission Statement

The Department of Civil, Environmental, & Architectural Engineering (CEAE) at WPI empowers students to become global stewards of the planet and work toward a better, sustainable tomorrow. CEAE's flexible, project-based curriculum lets students explore multiple disciplines, emphasizing civic responsibility and leadership.

Working with our world-class faculty and using WPI's state-of-the-art facilities, our students conduct research with global implications in areas like structural design, construction, infrastructure, health monitoring, sustainability, water resources, and pollution prevention and remediation. This important work moves outside our walls to Global Project Centers as students address real-world civil engineering problems, such as maintaining sustainable infrastructure and protecting the earth's resources.

The CEAE Department offers B.S. degrees in Civil Engineering, Environmental Engineering, and Architectural Engineering, as well as a Minor in Architectural Engineering.

Architectural Engineering Major

Degree Type

Bachelor of Science

DIRECTOR: S. VAN DESSEL (CEAE)

ASSOCIATED FACULTY: L. D. Albano (CEAE), T. El-Korchi (CEAE), S. Farzin (CEAE), S. Liu (CEAE), N. Ma (CEAE), S. Van Dessel (CEAE)

Mission Statement

Architectural Engineering is a discipline that focuses on the planning, design, construction and operation of buildings and, particularly, on their parts that support the functioning of the inner space and the undertaking of human activities, including environmental protection, comfort, well-being, sustainability and security. One of the major focuses of the architectural engineering program at WPI is the use of energy in buildings, and this is addressed through courses and projects that incorporate engineering science and design fundamentals that relate to those building parts, e.g., envelope, heating and air conditioning, and electrical systems, which impact the consumption of energy and natural resources. The program seeks to impart to students strong technical competence in fundamental engineering principles as they are applied to a sustainable built environment. The program, in addition, seeks to foster a student's creative undertaking and his/her development of high standards of professionalism. The project approach at WPI offers students a unique opportunity to explore the humanistic, technological, societal, economic, legal, and environmental issues surrounding architectural design problems. The architectural engineering degree prepares students for careers in the private and public sectors, architectural and engineering consulting, real estate and construction firms, and advanced graduate studies.

Program Educational Outcomes

The objective of the undergraduate program in Architectural Engineering is to prepare graduates for successful careers in the Architectural Engineering profession. A few years after graduation WPI Architectural Engineering graduates are expected to have the ability to:

1. Attain registration as Professional Engineers,
2. Earn a graduate degree in Architectural Engineering or a related discipline,
3. Enhance their skills through continued education,
4. Serve their profession through engagement with professional societies,
5. Demonstrate commitment to sustainable design principles within their professional work

Student Outcomes

The Student Outcomes for the Bachelor degree in Architectural Engineering are that all graduates will attain:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

8. the design level in one of the four architectural engineering areas, the application level in a second area, and the comprehension level in the remaining two areas.

Program Distribution Requirements for the Architectural Engineering B.S.

The program is designed according to the ABET criteria for Architectural Engineering accreditation. The four basic architectural engineering curriculum areas are building structures, building mechanical systems, building electrical systems, and construction/construction management. The normal period of residency at WPI is 16 terms. In addition to WPI requirements applicable to all students, students wishing to receive a Bachelor degree in "Architectural Engineering" must satisfy the following distribution requirements:

Mathematics, Basic Science, and Supplemental Science (Minimum 12/3 Units)

Must include a minimum of 10/3 units of a combination of Mathematics and Basic Science. Mathematics must include differential and integral calculus (4/3 units), differential equations (1/3 unit), statistics (1/3 unit), and matrices and linear algebra (1/3 unit). Science must include 2/3 unit in calculus-based physics (PH 1110 or PH 1111 and PH 1120 or PH 1121), and 1/3 unit in chemistry.

Must include 2/3 units of Supplemental Science, including 1/3 unit in thermodynamics (can be fulfilled by PH 2101 or other approved equivalent course such as ES 3001), and 1/3 unit in fluid mechanics (can be fulfilled by ES 3004).

Differential and Integral Calculus (4/3 Units). Students may not receive credit for both MA 1020 and MA 1021; students may not receive credit for both MA 1022 and MA 1120.

Item #	Title	Units
MA 1021	Calculus I	1/3
MA 1022	Calculus II	1/3
MA 1023	Calculus III	1/3
MA 1024	Calculus IV	1/3

Differential Equations (1/3 Unit)

Item #	Title	Units
MA 2051	Ordinary Differential Equations	1/3

Statistics (1/3 Unit)

Item #	Title	Units
MA 2611	Applied Statistics I	1/3

Matrices and Linear Algebra (1/3 Unit)

Item #	Title	Units
MA 2071	Matrices and Linear Algebra I	1/3

Calculus-Based Physics (2/3 Units). Students may not receive credit for both PH 1110 and PH 1111; students may not receive credit for both PH 1120 and PH 1121.

Item #	Title	Units
PH 1110	General Physics—Mechanics	1/3
PH 1111	Principles of Physics—Mechanics	1/3
PH 1120	General Physics—Electricity and Magnetism	1/3
PH 1121	Principles of Physics—Electricity and Magnetism	1/3

Chemistry (1/3 Unit)

Item #	Title	Units
CH 1010	Chemical Properties, Bonding, and Forces	1/3

Supplemental Science - Thermodynamics (1/3 Unit)

Item #	Title	Units
ES 3001	Introduction to Thermodynamics	1/3
PH 2101	Principles of Thermodynamics	1/3

Supplemental Science - Fluid Mechanics (1/3 Unit)

Item #	Title	Units
ES 3004	Fluid Mechanics	1/3

Architectural Engineering Science and Design (Minimum 21/3 Units)

Must include 7 units of Architectural Engineering Science and Design in the different areas of architectural engineering, distributed as follows or with approved equivalents.

Must include the Capstone Design Activity (1 unit) through the MQP that achieves design proficiency in either the structural or mechanical area.

Architectural Engineering Complements (Minimum 2/3 Units)

Item #	Title	Units
AR 2114	Modern Architecture in the American Era, 1750-2001 and Beyond	1/3
AREN 2023	Introduction to Architectural Engineering Systems	1/3

2/3 units of architectural engineering complements, including introduction to architectural engineering (AREN 2023) and topics related to the history and theory of architecture (AR 2114).

Construction/Construction Management (Minimum 2/3 Units)

Item #	Title	Units
CE 3020	Project Management	1/3
CE 3022	Legal Aspects of Professional Practice	1/3
CE 3025	Project Evaluation	1/3

2/3 units in construction/construction management including project evaluation (CE 3025) or Engineering Economics (OIE 2850), and either legal aspects of professional practive (CE 3022) or project management (CE 3020).

Building Mechanical Systems (Minimum 5/3 Units)

Item #	Title	Units
AREN 3003	Principles of HVAC Design for Buildings	1/3
AREN 3006	Advanced HVAC System Design	1/3
AREN 3020	Architectural Design IV - Building Energy Simulation	1/3
AREN 3022	Architectural Design V - Building Envelope Design	1/3
AREN 3024	Building Physics	1/3
ES 3004	Fluid Mechanics	1/3
PH 2101	Principles of Thermodynamics	1/3

5/3 units in building mechanical systems including Building Physics (AREN 3024), Principles of HVAC design for buildings (AREN 3003), Advanced HVAC system design (AREN 3006), and two integrated architectural design studios: Architectural Design IV - Building energy stimulation (AREN 3020), and Architectural Design V - Building Envelop Design (AREN 3022).

Building Electrical Systems (Minimum 2/3 Units)

Item #	Title	Units
AREN 2004	Architectural Design II - Light and Lighting Systems	1/3
AREN 2025	Building Electrical Systems	1/3

2/3 units in building electrical systems with topics in building electrical systems (AREN 2025) and Architectural Design II - Lighting and Lighting Systems (AREN 2004).

Building Structural Systems (Minimum 5/3 Units)

Item #	Title	Units
CE 2000	Analytical Mechanics I	1/3
CE 2001	Analytical Mechanics II	1/3
CE 2002	Introduction to Analysis and Design	1/3
CE 3006	Design of Steel Structures	1/3
CE 3008	Design of Reinforced Concrete Structures	1/3
CE 3010	Structural Engineering	1/3
CE 3044	Foundation Engineering	1/3
ES 2501	Introduction to Static Systems	1/3
ES 2502	Stress Analysis	1/3
PH 1110	General Physics—Mechanics	1/3
PH 1111	Principles of Physics—Mechanics	1/3

5/3 units in building structural systems including Analytical Mechanics 1 and 2 (CE 2000 and CE 2001), Introduction to Analysis and Design (CE 2002), and two design level structural engineering courses (such as CE 3006, CE 3008, CE 3010, CE 3044, or CE 4007).

General Architectural Design (Minimum 2/3 Units)

Item #	Title	Units
AREN 2002	Architectural Design I	1/3
AREN 2004	Architectural Design II - Light and Lighting Systems	1/3
AREN 3002	Architectural Design III	1/3
AREN 3020	Architectural Design IV - Building Energy Simulation	1/3
AREN 3022	Architectural Design V - Building Envelope Design	1/3

2/3 units in general architectural design including Architectural Design I (AREN 2002), and Architecural Design III (AREN 3002).

Capstone Design (3/3 Units). Must include the Capstone Design activity through the MQP that achieves design proficiency in either the structural or mechanical area.

Experimentation (1/3 Unit). Must include 1/3 unit in Experimentation (fulfilled by AREN 3003, AREN 3020, ME 3901, CE 3026).

Great Problem Seminar (GPS) courses can only be used to fulfill the HUA, SSPS, or Free Elective requirements.

For more information please consult the website for this major at https://www.wpi.edu/academics/departments/architectural-engineering.

Civil Engineering Major

Degree Type

Bachelor of Science

C. M. EGGLESTON, HEAD; M. TAO, ASSOCIATE HEAD

PROFESSORS: C. M. Eggleston, T. El-Korchi, N. Rahbar, H. W. Walker

ASSOCIATE PROFESSORS: L. D. Albano, J. A. Bergendahl, J. D. Dudle

P. P. Mathisen, A. R. Sakulich, M. Tao, S. Van Dessel

ASSISTANT PROFESSORS: S. Liu, N. Ma

ASSOCIATE PROFESSORS OF TEACHING: D. Rosbach

ASSISTANT PROFESSORS OF TEACHING: L. Abu-Lail, S. Farzin

ASSISTANT TEACHING PROFESSORS: J. A. Rosewitz

SENIOR INSTRUCTORS: S. LePage

EMERITUS PROFESSORS: R. Fitzgerald, J. C. O'Shaughnessy, R. Pietroforte. G. Salazar

ASSOCIATED FACULTY: T. Camesano (CHE), S. Kmiotek (CHE)

Mission Statement

The Civil Engineering program at WPI prepares graduates for careers in civil engineering, emphasizing professional practice, civic contributions, and leadership, sustained by active life-long learning. The curriculum combines a project-based learning environment with a broad background in the fundamental principles of civil engineering. Students have the flexibility to explore various civil engineering disciplines and career opportunities.

Program Educational Outcomes

The Program Educational Objectives for the Bachelor degree in Civil Engineering are that our alumni will:

1. be global citizens and stewards for the planet with an appreciation for the interrelationships between basic knowledge, technology, and society, while solving the challenges facing civil engineers in the 21st century.
2. be able to apply the fundamental principles of mathematics, science and engineering to analyze and solve problems and to produce creative sustainable design.
3. have the ability to engage in life-long learning, enhance their technical skills through graduate studies and continuing education, and through relevant experience.
4. exhibit leadership in the civil engineering profession, demonstrate excellent communication skills, be engaged in professional societies, demonstrate understanding of ethical responsibility, and have a professional demeanor necessary for a successful civil engineering career.

Student Outcomes

The Student Outcomes for the Bachelor degree in Civil Engineering are that all graduates will attain:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

Program Distribution Requirements for the Civil Engineering Major

The normal period of residency at WPI is 16 terms. In addition to WPI requirements applicable to all students, students wishing to receive the ABET accredited degree designated “Civil Engineering” must satisfy certain distribution requirements as follows:

Mathematics and Basic Science (Minimum 12/3 Units)

Mathematics (Minimum 7/3 Units)

Must include 7/3 units in Mathematics (MA), including differential and integral calculus, differential equations, probability, and statistics.

Differential and Integral Calculus. Students may not receive credit for both MA 1020 and MA 1021; students may not receive credit for both MA 1022 and MA 1120.

Item #	Title	Units
MA 1020	Calculus I with Preliminary Topics	1/3
MA 1021	Calculus I	1/3
MA 1022	Calculus II	1/3
MA 1023	Calculus III	1/3
MA 1024	Calculus IV	1/3
MA 1120	Calculus II (Semester Version)	1/3

Differential Equations

Item #	Title	Units
MA 2051	Ordinary Differential Equations	1/3

Statistics. The course listed is the recommended course. Students wishing to take a different statistics course should consult their academic advisor.

Item #	Title	Units
MA 2611	Applied Statistics I	1/3

Probability

Item #	Title	Units
MA 2621	Probability for Applications	1/3

Physics (Minimum 1/3 Units)

Must include at least 1/3 unit in physics (PH). Although any PH course can be used to satisfy this requirement, the courses listed below are recommended.

Recommended Physics Courses

Item #	Title	Units
PH 1110	General Physics—Mechanics	1/3
PH 1111	Principles of Physics—Mechanics	1/3

Chemistry (Minimum 2/3 Units)

Must include at least 2/3 units in chemistry (CH). Although any CH course can be used to satisfy this requirement, the courses listed below are recommended.

Recommended Chemistry Courses

Item #	Title	Units
CH 1010	Chemical Properties, Bonding, and Forces	1/3
CH 1020	Chemical Reactions	1/3

Additional Science (Minimum 1/3 Units)

Must include at least 1/3 unit in additional science (BB or GE). Although any BB or GE courses can be used to satisfy this requirement, the courses listed below are recommended. Students with a strong background in biology may consider 2000-level BB courses.

Recommended Additional Science Courses

Item #	Title	Units
BB 1001	Introduction to Biology	1/3
BB 1002	Environmental Biology	1/3
BB 1025	Human Biology	1/3
BB 1035	Biotechnology	1/3
BB 1045	Biodiversity	1/3
GE 2341	Geology	1/3

Mathematics and Basic Science Elective (Minimum 1/3 Units)

Must include at least 1/3 unit elective from BB, CH, GE, MA, PH, or FY courses that satisfy BB, CH, GE, MA or PH.

Engineering Science and Design (Minimum 18/3 Units)

Fundamental Engineering Science (Minimum 6/3 Units)

Must include 2/3 units in solid mechanics, 1/3 unit in soil mechanics, 1/3 unit in fluid mechanics, and 2/3 units of additional engineering science courses from an approved list of ES courses.

Solid Mechanics (Minimum 2/3 Units)

Item #	Title	Units
CE 2000	Analytical Mechanics I	1/3
CE 2001	Analytical Mechanics II	1/3
ES 2501	Introduction to Static Systems	1/3
ES 2502	Stress Analysis	1/3

Students may not receive credit for both CE 2000 and ES 2501; students may not receive credit for both CE 2001 and ES 2502.

Soil Mechanics (Minimum 1/3 Units)

Item #	Title	Units
CE 3041	Soil Mechanics	1/3

Fluid Mechanics (Minimum 1/3 Units)

Item #	Title	Units
ES 3004	Fluid Mechanics	1/3

Additional Engineering Science Courses (Minimum 2/3 Units)

Item #	Title	Units
CE 2002	Introduction to Analysis and Design	1/3
ES 2001	Introduction to Materials Science	1/3
ES 2503	Introduction to Dynamic Systems	1/3
ES 2800	Environmental Impacts of Engineering Decisions	1/3
ES 3001	Introduction to Thermodynamics	1/3
ES 3002	Mass Transfer	1/3

Must include 2/3 units of engineering science from the list above.

Civil Engineering (Minimum 12/3 Units)

Core Civil Engineering (Minimum 4/3 Units)

Item #	Title	Units
CE 3010	Structural Engineering	1/3
CE 3020	Project Management	1/3
CE 3050	Traffic Engineering	1/3
CE 3059	Environmental Engineering	1/3

Must include 4/3 units in Core Civil Engineering, including Structural Engineering, Transportation Engineering, Project Management, and Environmental Engineering.

Civil Engineering Depth (Minimum 3/3 Units)

Must include 3/3 units of civil engineering depth courses at the 3000-level or above, fulfilled by all CE courses not listed in other notes and with at least 2/3 unit from within one sub-discipline of CE. The sub-disciplines are Structural and Geotechnical Engineering; Environmental Engineering and Water Resources; and Planning, Development, and Project Management.

Civil Engineering Sub-Disciplines:

- Structural and Geotechnical Engineering

Item #	Title	Units
CE 3006	Design of Steel Structures	1/3
CE 3008	Design of Reinforced Concrete Structures	1/3
CE 3031	Building Information Modeling: Software Tools and Principles	1/3
CE 3044	Foundation Engineering	1/3
CE 4007	Matrix Analysis of Structures	1/3

- Environmental Engineering and Water Resources

Item #	Title	Units
CE 3060	Water Treatment	1/3
CE 3061	Sustainable Wastewater Engineering: Treatment and Reuse	1/3
CE 3062	Hydraulics	1/3
CE 3074	Environmental Analysis	1/3
CE 4061	Hydrology	1/3
CE 4063/CHE 4063	Transport & Transformations in the Environment	1/3
CE 4600	Hazardous and Industrial Waste Management	1/3
CE 4610	Solid Waste Engineering	1/3

- Planning, Development, and Project Management

Item #	Title	Units
CE 3022	Legal Aspects of Professional Practice	1/3
CE 3025	Project Evaluation	1/3
CE 3031	Building Information Modeling: Software Tools and Principles	1/3
CE 3051	Pavement Engineering	1/3
CE 3070	Urban and Environmental Planning	1/3
CE 3074	Environmental Analysis	1/3
CE 4061	Hydrology	1/3
CE 4071	Land Use Development and Controls	1/3

Civil Engineering Laboratory Experience (Minimum 2/3 Units)

Item #	Title	Units
CE 2020	Surveying	1/3
CE 3026	Materials of Construction	1/3
CE 4060	Environmental Engineering Laboratory	1/3

Must include 2/3 units of civil engineering laboratory experience.

Major Qualifying Project (MQP) (Minimum 3/3 Units)

Must include 3/3 unit of MQP, including 1/3 unit of capstone design.

Subareas of Civil Engineering

Civil and environmental engineers design the structures and systems for our modern world – creating communities that are livable, sustainable, and protective of the environment. From buildings to transportation systems to clean water and waste management, civil and environmental engineers make a difference in the quality of everyday lives. While these systems have existed for hundreds of years, civil and environmental engineers today are innovative thinkers, considering climate adaptation, energy efficiency, and smart technologies as they design the built environment for the future.

Structural and Geotechnical Engineering (L. Albano, T. El-Korchi, N. Rahbar, A. Sakulich, M. Tao)

Structural and geotechnical engineering focus on the analysis, design, and construction of infrastructure above and below ground. Students study the mechanics and engineering properties of construction materials, and the behavior of the subsurface. This knowledge is used to design buildings, bridges, roads, dams, landfills, and other parts of the built environment that are needed for daily life. Beyond structural and geotechnical design, students may explore climate change impacts on infrastructure, smart sensors for degradation monitoring, and energy harvesting from materials.

Environmental Engineering and Water Resources (L. Abu-Lail, J. Bergendahl, J. Dudle, C. Eggleston, S. LePage, P. Mathisen, H. Walker)

Environmental engineers design and construct systems to protect public health, improve quality of life, and improve natural ecosystems. Students apply principles of chemistry, biology, and physics to design systems for water supply, wastewater treatment, and water resource protection. They are also concerned with hazardous waste remediation, air pollution control, and mitigating pollutant impacts on the environment. Increasingly, environmental engineers are challenged with adapting to climate change impacts and ensuring sustainable solutions in both local and global communities.

Planning, Development, and Project Management (S. LePage, P. Mathisen, J. Rosewitz)

Engineers working in the built environment assess the broader context of planning, development goals, and transportation systems to design smart, sustainable, and livable communities. They also inform and guide the public decision-making process as communities redesign their infrastructure. To deliver projects, engineers working in project management consider economics, legal aspects, and execution of construction projects. They work to plan, estimate, schedule, manage, and source materials using modern multidisciplinary information technologies and control systems.

Major Qualifying Projects

Civil Engineering MQPs are capstone design activities that span a wide range of topics in the areas of structural and geotechnical design, environmental engineering, water resources, planning, development, transportation, and project management. Students may select project topics which are related to their subarea of emphasis, or may develop projects that incorporate multiple subareas. Projects draw upon prior course work, and exemplify the type of work students will encounter in their post-graduate pursuits. Project activities can include design, construction, planning, research, laboratory investigations, field work, and collaborative work with public and private organizations. Typically, the MQP includes analysis of a comprehensive civil engineering problem, consideration of alternative solutions, and optimization of a solution. A major objective of the MQP is the development of sound engineering judgment, incorporating engineering economics and social factors into problem-solving.

Fundamentals of Engineering Exam

The first step to becoming a licensed professional engineer is passing the Fundamentals of Engineering (FE) exam. Licensure is used to ensure public safety by requiring practicing consultants to demonstrate their qualifications based on education, experience, and examinations, including the FE exam. Engineers who attain licensure enjoy career benefits that allow them to offer consulting services and rise to positions of responsibility. All Civil Engineering majors are strongly encouraged to take the FE exam during their senior year. The exam is offered year-round.

Combined Bachelor/Master's Program

Continued studies beyond the bachelor's degree are valuable for career advancement and professional engineering licensure. Combined Bachelor/Master's degree programs offer the advantage of double-counting up to 12 credits, including up to six credits of advanced coursework (4000-level) at the undergraduate level, for both the Bachelor's and Master's degree requirements. Specific CE requirements and more information can be obtained from the Civil, Environmental, and Architectural Engineering Department office. Programs leading to the Master of Science and Master of Engineering are available.

Environmental Engineering Major

Degree Type

Bachelor of Science

DIRECTOR: J. A. BERGENDAHL

ASSOCIATED FACULTY: L. Abu-Lail (CHE/CEAE), J. A. Bergendahl (CEAE), T. Camesano (CHE), J. D. Dudle (CEAE), C. M. Eggleston (CEAE), S. Kmiotek (CHE), S. LePage (CEAE), P. P. Mathisen (CEAE), M. Tao (CEAE), H. W. Walker (CEAE)

Mission Statement

Environmental engineers are challenged not only with mastering technical and scientific principles, but also understanding the broader context within which environmental solutions are implemented. The environmental engineering program encourages coursework in the humanistic and social aspects of engineering decisions, public health management, and environmental preservation. The projects program at WPI offers environmental engineering students a unique opportunity to explore the complex humanistic, economic, legal, and political issues surrounding environmental engineering problems.

The Environmental Engineering degree program prepares students for careers in both the private and public sectors, consulting, industry, and advanced graduate study.

Program Educational Outcomes

The Program Educational Objectives for the Bachelor degree in Environmental Engineering are that our alumni will:

1. Have successful, impactful, and productive careers in environmental engineering and related professions, where sound science and engineering principles are applied to solve environmental problems in a socially and financially responsible manner while adhering to the code of ethics for engineers.
2. Be leaders who are at the forefront of environmental change and technological advancements for the sustainable betterment of environmental systems and quality of life.
3. Meet the changing needs of the profession through lifelong learning, such as graduate education, engagement in the profession and organizations, and attainment of professional licensure.

Student Outcomes

The Student Outcomes for the Bachelor degree in Environmental Engineering are that all graduates will attain:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Program Distribution Requirements for the Environmental Engineering Major

The normal period of residency at WPI is 16 terms. In addition to WPI requirements applicable to all students, students wishing to receive the ABET accredited degree designated “Environmental Engineering” must satisfy certain distribution requirements as follows:

Mathematics (Minimum 6/3 Units)

Mathematics (MA) must include differential and integral calculus, differential equations, and statistics. Students may not receive credit for both MA 1020 and MA 1021; students may not receive credit for both MA 1022 and MA 1120. For statistics, the course listed is the recommended course. Students wishing to take a different statistics course should consult their academic advisor.

Mathematics Courses

Item #	Title	Units
MA 1020	Calculus I with Preliminary Topics	1/3
MA 1021	Calculus I	1/3
MA 1022	Calculus II	1/3
MA 1023	Calculus III	1/3
MA 1024	Calculus IV	1/3
MA 1120	Calculus II (Semester Version)	1/3
MA 2051	Ordinary Differential Equations	1/3
MA 2611	Applied Statistics I	1/3

Basic Science (Minimum 6/3 Units)

Basic Science must include 1/3 unit of biology (BB; introductory biology, environmental biology, or biodiversity); 3/3 units of chemistry (CH) including equilibrium and kinetics; 1/3 unit of earth science; and 1/3 unit of calculus-based physics (PH).

Biology (Minimum 1/3 Units)

Item #	Title	Units
BB 1001	Introduction to Biology	1/3
BB 1002	Environmental Biology	1/3
BB 1045	Biodiversity	1/3

Chemistry (Minimum 3/3 Units)

Item #	Title	Units
CH 1010	Chemical Properties, Bonding, and Forces	1/3
CH 1020	Chemical Reactions	1/3
CH 1030	Kinetics, Equilibrium and Thermodynamics	1/3

While other CH courses may satisfy this requirement, the listed courses are recommended. Students wishing to take different chemistry courses should consult their academic advisor.

Earth Science (Minimum 1/3 Units)

Item #	Title	Units
GE 2341	Geology	1/3

Calculus-Based Physics (Minimum 1/3 Units)

Item #	Title	Units
PH 1110	General Physics—Mechanics	1/3
PH 1111	Principles of Physics—Mechanics	1/3

While other PH courses may satisfy this requirement, the listed courses are recommended. Students wishing to take a different physics course should consult their academic advisor.

Supplemental Science (Minimum 1/3 Units)

Supplemental Science must include 1/3 unit in microbiology, ecology, spectroscopy, or organic chemistry.

Supplemental Science Courses

Item #	Title	Units
BB 2003	Fundamentals of Microbiology	1/3
BB 2040	Principles of Ecology	1/3
CH 1040	Spectroscopy in Organic and Polymer Chemistry	1/3
CH 2310	Organic Chemistry I	1/3

Engineering Science and Design (Minimum 15/3 Units)

Fundamental Engineering Science

Must include 1/3 unit in fluid mechanics; 1/3 unit in thermodynamics; 2/3 unit in mechanics and materials; 2/3 unit in mass transfer, heat transfer and/or system engineering.

Fluid Mechanics (Minimum 1/3 Units)

Item #	Title	Units
ES 3004	Fluid Mechanics	1/3

Thermodynamics (Minimum 1/3 Units)

Item #	Title	Units
ES 3001	Introduction to Thermodynamics	1/3

Mechanics and Materials (Minimum 2/3 Units)

Item #	Title	Units
CE 2000	Analytical Mechanics I	1/3
CE 2001	Analytical Mechanics II	1/3
ES 2001	Introduction to Materials Science	1/3
ES 2501	Introduction to Static Systems	1/3
ES 2502	Stress Analysis	1/3
ES 2503	Introduction to Dynamic Systems	1/3

Students may not receive credit for both CE 2000 and ES 2501; students may not receive credit for both CE 2001 and ES 2502.

Mass Transfer, Heat Transfer, and/or System Engineering (Minimum 2/3 Units)

Item #	Title	Units
ES 3002	Mass Transfer	1/3
ES 3003	Heat Transfer	1/3
ES 3501	A Project-Based Introduction to Systems Engineering	1/3

Environmental Engineering

Must include 2/3 unit in core topics, including Environmental Engineering and Hydraulics; 2/3 unit of laboratory experimentation; 5/3 unit of environmental engineering breadth and depth courses at the 3000 or 4000 level.

Core Topics, including Environmental Engineering and Hydraulics (Minimum 2/3 Units)

Item #	Title	Units
CE 3059	Environmental Engineering	1/3
CE 3062	Hydraulics	1/3

Laboratory Experimentation (Minimum 2/3 Units)

Item #	Title	Units
CE 2020	Surveying	1/3
CE 3026	Materials of Construction	1/3
CE 4060	Environmental Engineering Laboratory	1/3

Must include CE 4060 and one additional laboratory class from the list.

Environmental Engineering Breadth and Depth courses at the 3000 or 4000 level (Minimum 5/3 Units)

Item #	Title	Units
CE 3020	Project Management	1/3
CE 3041	Soil Mechanics	1/3
CE 3060	Water Treatment	1/3
CE 3061	Sustainable Wastewater Engineering: Treatment and Reuse	1/3
CE 3070	Urban and Environmental Planning	1/3
CE 3074	Environmental Analysis	1/3
CE 4061	Hydrology	1/3
CE 4063/CHE 4063	Transport & Transformations in the Environment	1/3
CE 4071	Land Use Development and Controls	1/3
CE 4600	Hazardous and Industrial Waste Management	1/3
CE 4610	Solid Waste Engineering	1/3

Courses may be selected from the list, but can include at most one of CE 3070, CE 3074, or CE 4071.

Major Qualifying Project (MQP) (Minimum 3/3 Units)

Must include 3/3 unit of MQP, including 1/3 unit of capstone design.

Major Qualifying Projects

Environmental Engineering MQPs are capstone design activities that span a wide range of topics in the areas of water resources, water and wastewater treatment, hazardous waste remediation, environmental contamination, resource management, and air quality control. Projects draw upon prior course work, and exemplify the type of work students will encounter in their post-graduate pursuits. Project activities can include design, planning, research, laboratory investigations, field work, and collaborative work with public and private organizations. Following the WPI educational model of theory and practice, environmental engineering student projects provide unique, hands-on opportunities to explore the multifaceted considerations surrounding environmental engineering problems on local and global levels, and to improve quality of life while also preserving natural ecosystems

Fundamentals of Engineering Exam

The first step to becoming a licensed professional engineer is passing the Fundamentals of Engineering (FE) exam. Licensure is used to ensure public safety by requiring practicing consultants to demonstrate their qualifications based on education, experience, and examinations, including the FE exam. Engineers who attain licensure enjoy career benefits that allow them to offer consulting services and rise to positions of responsibility. All Environmental Engineering majors are strongly encouraged to take the FE exam during their senior year. The exam is offered year-round.

Combined Bachelor/Master’s Program

Continued studies beyond the bachelor’s degree are valuable for career advancement and professional engineering licensure. Combined Bachelor/Master’s degree programs offer the advantage of double-counting up to 12 credits, including up to six credits of advanced coursework (4000-level) at the undergraduate level, for both the Bachelor’s and Master’s degree requirements. Specific environmental engineering requirements and more information can be obtained from the Civil, Environmental, and Architectural Engineering Department office. Programs leading to the Master of Science and Master of Engineering are available.

Architectural Engineering Minor

Degree Type

Minor

For students who are not AREN majors and are interested in broadening their exposure to and understanding of architectural engineering, the Architectural Engineering Program offers a Minor in Architectural Engineering. WPI policy requires that no more than one unit of course work be double counted toward other degree requirements.

Program Distribution Requirements for the Architectural Engineering Minor

Successful candidates for the Minor in AREN must complete two units of work from courses with the prefix "AREN" as outlined below.

Required Architectural Engineering Courses (Minimum 3/3 Units)

Item #	Title	Units
AREN 2002	Architectural Design I	1/3
AREN 2023	Introduction to Architectural Engineering Systems	1/3
AREN 3003	Principles of HVAC Design for Buildings	1/3
AREN 2002	Architectural Design I	1/3

Elective Architectural Engineering Courses (Minimum 3/3 Units)

Item #	Title	Units
AREN 2025	Building Electrical Systems	1/3
AREN 2004	Architectural Design II - Light and Lighting Systems	1/3
AREN 3002	Architectural Design III	1/3
AREN 3006	Advanced HVAC System Design	1/3
AREN 3024	Building Physics	1/3
AREN 3022	Architectural Design V - Building Envelope Design	1/3
AREN 2025	Building Electrical Systems	1/3

Civil Engineering Major with Environmental Concentration

Degree Type

Concentration

Civil Engineering majors may choose to focus their studies by obtaining an Environmental concentration. An Environmental concentration in the CE major focuses on the planning, design, construction, operation and regulation of water quality control systems related to water supply and waste treatment. Additional areas of focus include hydrology, hydraulics, water resources, solid and hazardous waste management, waste minimization, public health, and air pollution control.

Students electing to pursue the Environmental concentration follow a general curriculum in Civil Engineering, with emphasis on the environmental engineering subarea. Such preparation leads to an ABET accredited degree, and is an excellent start for entry-level professional placement or graduate study in environmental engineering.

Program Distribution Requirements for the Civil Engineering Major with Environmental Concentration

The Environmental concentration is earned by completing six courses from the following list (or alternate courses through petition) plus an MQP in the environmental area. Typical MQPs include analysis and design of innovative water treatment systems; water quality monitoring and pollutant control; water resources analysis and groundwater studies; innovative hazardous and industrial waste solutions; and air pollution control.

Environmental Concentration Courses (Minimum 6/3 Units)

Item #	Title	Units
CE 3059	Environmental Engineering	1/3
CE 3060	Water Treatment	1/3
CE 3061	Sustainable Wastewater Engineering: Treatment and Reuse	1/3
CE 3062	Hydraulics	1/3
CE 3070	Urban and Environmental Planning	1/3
CE 3074	Environmental Analysis	1/3
CE 4060	Environmental Engineering Laboratory	1/3
CE 4061	Hydrology	1/3
CE 4063/CHE 4063	Transport & Transformations in the Environment	1/3
CE 4071	Land Use Development and Controls	1/3
CE 4600	Hazardous and Industrial Waste Management	1/3
CE 4610	Solid Waste Engineering	1/3
CHE 3201	Kinetics and Reactor Design	1/3

Electrical and Computer Engineering

D. R. Brown, HEAD; R. Ludwig, ASSOCIATE HEAD

PROFESSORS: D. R. Brown, E. A. Clancy, X. Huang, R. Ludwig, S. Makarov, J. A. McNeill, W.R. Michalson, K. Pahlavan, P. Schaumont, B. Sunar, A. Wyglinski

TEACHING PROFESSORS: J. P. Monat

ASSOCIATE PROFESSORS: U. Guler, B. Tang

ASSISTANT PROFESSORS: S. Bhada, F. Ganji, B. Islam, S. Tajik, Z. Zhang

ASSISTANT PROFESSOR OF TEACHING: K. Mus

ASSISTANT TEACHING PROFESSORS: M. Ashegan, Y. Doroz, G. Noetscher, E. Uzunovic

INSTRUCTOR: S. J. Bitar

EMERITUS PROFESSORS: K. A. Clements, D. Cyganski, J. Duckworth, F. J. Looft, J. A. Orr, P. C. Pedersen

Mission Statement

To be prepared for employment as a contributing engineer and/or for graduate-level education, students within the ECE Department receive instruction that is balanced between theory and practice. In fact, much of our curriculum integrates theory and practice within each course. It is common to study new devices and techniques, and then immediately work with these devices/techniques in a laboratory setting. In response to the breadth of ECE, all students work with their academic advisor to develop a broad-based program of study. As with most engineering curricula, ECE study includes a solid foundation of mathematics and science. Discipline-specific study in ECE usually begins early in a student's career — during the second half of the freshman year — with courses providing a broad overview of the entire field. During the sophomore and junior years, students learn the core analysis, design and laboratory skills necessary to a broad range of ECE sub-disciplines. When desired, specialization within ECE occurs during the junior and senior years. In addition, all students complete a major qualifying project (MQP). This project, typically completed in teams during the senior year, is an individualized design or research project that draws from much of the prior instruction. Utilizing the benefit of individualized instruction from one or more faculty members, students develop, implement and document the solution to a real engineering problem. Many of these projects are sponsored by industry, or are associated with ongoing faculty research. These projects form a unique bridge to the engineering profession.

Program Educational Objectives

The Electrical and Computer Engineering Department offers a balanced, integrated curriculum strong in both fundamentals and state-of-the-art knowledge. The curriculum embraces WPI's philosophy of education, with a program characterized by curricular flexibility, student project work such as the Interactive Qualifying Project, and active involvement of students in their learning.

The Electrical and Computer Engineering Program seeks to have alumni who:

- are successful professionals who demonstrate in their work a breadth of knowledge in the field of electrical and computer engineering,
- are engaged in active lifelong learning, using appropriate learning strategies, to acquire and apply new knowledge as needed;
- are effective contributors in business and society, demonstrating the ability to communicate, work in teams, and understand the broad implications of their work;
- are engaged broadly in both their professional and personal lives, exhibiting effective leadership and informed citizenship.

Student Outcomes

Based on the department's educational objectives, students will achieve the following specific educational outcomes within a challenging and supportive environment:

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3. An ability to communicate effectively with a range of audiences.
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgement to draw conclusions.
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Course Coding

The second digit in electrical engineering course numbers is coded as follows:

0 — Circuits
1 — Fields
2 — Electronic Circuits and Systems
3 — Signals and Communication Systems

4 — Available for Future Use
5 — Machines, Power Systems
6 — Professional and Miscellaneous
7 — Projects, Laboratory, Independent Study
8 — Computers
9 — Electronic Devices
NOTE: Courses listed in previous catalogs with “EE” as the prefix and the same course number as below are considered to be the SAME COURSE .

Electrical and Computer Engineering Major

Degree Type
Bachelor of Science

The normal period of residency at WPI is 16 terms. In addition to WPI requirements applicable to all students, students wishing to receive the major designated “Electrical and Computer Engineering” must satisfy certain distribution requirements. These requirements apply to 10 units of study in the areas of mathematics, basic science, and engineering science and design as follows:

Program Distribution Requirements for the Electrical and Computer Engineering Major

Mathematics and Basic Science (Minimum 12/3 Units)

To succeed in the study of electrical and computer engineering, the necessary foundation far exceeds what can be taught in a few introductory courses. In fact, if you even want to begin to understand what your ECE professors are talking about in lecture, you must begin with a firm basis in mathematics and the natural sciences. Moreover, whether applied to ECE or not, proficiency in mathematics and the sciences is a necessary quality for any educated engineer. Consequently, the ECE major requires a total of 4 units (12 courses) as the “Mathematics and Basic Science” distribution requirement.

The first part of this requirement is sufficient education in mathematics. At least 7 of the 12 required courses must be in this area, including coursework in differential calculus, integral calculus, differential equations, and probability. To see which specific courses fulfill these math requirements, please consult the mathematics course descriptions, and your academic advisor.

The other part of the requirement is coursework in the sciences. A solid understanding of physics is essential to any ECE student, being ultimately necessary for describing the behavior of electricity and magnetism as well as other physical phenomena. Knowledge of chemistry is useful as well, encompassing such topics as atomic and molecular behavior and the chemical properties of materials (such as silicon, which is quite useful in ECE). In recent years, knowledge of biology has also become important to electrical and computer engineers, particularly as biomedical-electrical technologies such as medical imaging continue to advance.

The ECE major requires at least 3 courses in the sciences, 2 of these courses must be in physics, and the remaining course may be in chemistry or biology depending on preference.

Finally, note that the total prescribed mathematics and science courses add up to 3 1/3 units (10 courses). To meet the distribution requirement, you then must take at least 2 more courses in any area of mathematics or science (that is, any other course with the prefix “MA”, “PH”, “CH”, “BB”, or “GE”).

Mathematics (Minimum 7/3 Units)

Item #	Title	Units
BCB 4004/MA 4603	Statistical Methods in Genetics and Bioinformatics	1/3
CS 2022/MA 2201	Discrete Mathematics	1/3
CS 4032/MA 3257	Numerical Methods for Linear and Nonlinear Systems	1/3
CS 4033/MA 3457	Numerical Methods for Calculus and Differential Equations	1/3
DS 4635/MA 4635	Data Analytics and Statistical Learning	1/3
MA 1020	Calculus I with Preliminary Topics	1/3
MA 1021	Calculus I	1/3
MA 1022	Calculus II	1/3
MA 1023	Calculus III	1/3
MA 1024	Calculus IV	1/3
MA 1033	Theoretical Calculus III	1/3
MA 1034	Theoretical Calculus IV	1/3
MA 1120	Calculus II (Semester Version)	1/3
MA 1801	Denksport	1/12
MA 1971	Bridge to Higher Mathematics	1/3
MA 2051	Ordinary Differential Equations	1/3
MA 2071	Matrices and Linear Algebra I	1/3
MA 2072	Accelerated Matrices and Linear Algebra I	1/3
MA 2073	Matrices and Linear Algebra II	1/3
MA 2210	Mathematical Methods in Decision Making	1/3
MA 2211	Theory of Interest I	1/3
MA 2212	Theory of Interest II	1/3
MA 2251	Vector and Tensor Calculus	1/3
MA 2271	Graph Theory	1/3
MA 2273	Combinatorics	1/3
MA 2431	Mathematical Modeling with Ordinary Differential Equations	1/3
MA 2610	Applied Statistics for the Life Sciences	1/3
MA 2611	Applied Statistics I	1/3
MA 2612	Applied Statistics II	1/3
MA 2621	Probability for Applications	1/3
MA 2631	Probability Theory	1/3
MA 3212	Actuarial Mathematics I	1/3
MA 3213	Actuarial Mathematics II	1/3
MA 3231	Linear Programming	1/3
MA 3233	Discrete Optimization	1/3
MA 3457/CS 4033	Numerical Methods for Calculus and Differential Equations	1/3
MA 3471	Advanced Ordinary Differential Equations	1/3
MA 3475	Calculus of Variations	1/3
MA 3627	Introduction to the Design and Analysis of Experiments	1/3
MA 3631	Mathematical Statistics	1/3
MA 3823	Group Theory	1/3
MA 3825	Rings and Fields	1/3
MA 3831	Principles of Real Analysis I	1/3
MA 3832	Principles of Real Analysis II	1/3
MA 4213	Loss Models I - Risk Theory	1/3
MA 4214	Loss Models II - Survival Models	1/3
MA 4216	Actuarial Seminar	
MA 4222	Top Algorithms in Applied Mathematics	1/3
MA 4235	Mathematical Optimization	1/3
MA 4237	Probabilistic Methods in Operations Research	1/3
MA 4291	Applied Complex Variables	1/3
MA 4411	Numerical Analysis of Differential Equations	1/3
MA 4451	Boundary Value Problems	1/3

MA 4473	Partial Differential Equations	1/3
MA 4631	Probability and Mathematical Statistics I	1/3
MA 4632	Probability and Mathematical Statistics II	1/3
MA 4891	Topics in Mathematics	1/3
MA 4892	Topics in Actuarial Mathematics	1/3
MA 4895	Differential Geometry	1/3

Must include at least 7/3 units of math (prefix MA). Mathematics must include differential and integral calculus, differential equations, and probability.

Physics (Minimum 2/3 Units)

Item #	Title	Units
PH 1110	General Physics—Mechanics	1/3
PH 1111	Principles of Physics—Mechanics	1/3
PH 1120	General Physics—Electricity and Magnetism	1/3
PH 1121	Principles of Physics—Electricity and Magnetism	1/3
PH 1130	Modern Physics	1/3
PH 1140	Oscillations and Waves	1/3
PH 1150	Introductory Physics of Living Systems	1/3
PH 2101	Principles of Thermodynamics	1/3
PH 2201	Intermediate Mechanics I	1/3
PH 2202	Intermediate Mechanics II	1/3
PH 2301	Electromagnetic Fields	1/3
PH 2501	Photonics	1/3
PH 2502	Lasers	1/3
PH 2510	Atomic Force Microscopy	1/3
PH 2520	Introduction to Astrophysics	1/3
PH 2540	Solar Systems	1/3
PH 2550/AE 2550	Atmospheric and Space Environments	1/3
PH 2601	Photonics Laboratory	1/3
PH 2651	Intermediate Physics Laboratory	1/3
PH 3206	Statistical Physics	1/3
PH 3301	Electromagnetic Theory	1/3
PH 3401	Quantum Mechanics I	1/3
PH 3402	Quantum Mechanics II	1/3
PH 3501	Relativity	1/3
PH 3502	Solid State Physics	1/3
PH 3503	Nuclear Physics	1/3
PH 3504	Optics	1/3
PH 4201/PH 511	Advanced Classical Mechanics	1/3

Must include at least 2/3 units of physics (prefix PH).

Chemistry OR Biology (Minimum 1/3 Units)

Item #	Title	Units
BB 1001	Introduction to Biology	1/3
BB 1002	Environmental Biology	1/3
BB 1003/BCB 1003	Exploring Bioinformatics and Computational Biology	1/3
BB 1025	Human Biology	1/3
BB 1035	Biotechnology	1/3
BB 1045	Biodiversity	1/3
BB 2002	Microbiology	1/3
BB 2003	Fundamentals of Microbiology	1/3
BB 2030	Plant Diversity	1/3
BB 2040	Principles of Ecology	1/3
BB 2050	Animal Behavior	1/3
BB 2550	Cell Biology	1/3
BB 2902	Enzymes, Proteins, and Purification	1/6
BB 2903	Anatomy and Physiology	1/6
BB 2904	Ecology, Environment, and Animal Behavior	1/6
BB 2915	Searching for Solutions in Soil: Microbial and Molecular Investigations	1/3
BB 2917	Hunting for Phage	1/3
BB 2920	Genetics	1/3
BB 2950	Molecular Biology	1/3
BB 3003	Medical Microbiology: Plagues of the Modern World, a Case Study Approach	1/3
BB 3010/BCB 3010	Simulation in Biology	1/3
BB 3050	Cancer Biology	1/3
BB 3080	Neurobiology	1/3
BB 3101	Human Anatomy & Physiology: Movement and Communication	1/3
BB 3102	Human Anatomy & Physiology: Transport and Maintenance	1/3
BB 3120	Plant Physiology	1/3
BB 3140	Evolution: Pattern and Process	1/3
BB 3512	Molecular Genetics Lab	1/6
BB 3513	Cell Culture Techniques for Animal Cells	1/6
BB 3515	Physiologic Systems Laboratory	1/3
BB 3517	Fermentation	1/6
BB 3519	Protein Purification	1/6
BB 3521	Microscopy	1/6
BB 3525	Plant Physiology	1/6
BB 3526	Phage Hunters: the Analysis	1/6
BB 3527	Molecular Biology and Genetic Engineering: Approaches and Applications	1/3
BB 3530	Immunotherapies: The Next Generation of Pharmaceuticals	1/3
BB 3570	Cell Culture Models for Tissue Regeneration	1/3
BB 3620	Developmental Biology	1/3
BB 3920	Immunology	1/3
BB 4150	Environmental Change: Problems and Approaches	1/3
BB 4170/CH 4170	Experimental Genetic Engineering	1/3
BB 4190/CH 4190	Regulation of Gene Expression	1/3
BB 4260	Synthetic Biology	1/3
BB 4801/BCB 4001	Bioinformatics	1/3
BB 4900	Capstone Experience in Biology and Biotechnology	1/3
CH 1010	Chemical Properties, Bonding, and Forces	1/3
CH 1020	Chemical Reactions	1/3
CH 1030	Kinetics, Equilibrium and Thermodynamics	1/3
CH 1040	Spectroscopy in Organic and Polymer Chemistry	1/3

CH 2310	Organic Chemistry I	1/3
CH 2320	Organic Chemistry II	1/3
CH 2330	Organic Chemistry III	1/3
CH 2360	Organic Laboratory	1/3
CH 2640	Experimental Chemistry I: Instrumental Analysis	1/3
CH 2650	Modern Physical Chemistry Methods	1/3
CH 2660	Organic Synthesis and Analysis Laboratory	1/3
CH 2670	Investigation of Coordination Complexes Through Inquiry	1/3
CH 3310	Advanced Organic Chemistry	1/3
CH 3410	Structure, Bonding, and Reactivity in Inorganic Chemistry	1/3
CH 3510	Chemical Thermodynamics	1/3
CH 3530	Quantum Chemistry	1/3
CH 3550	Chemical Dynamics	1/3
CH 4110	Protein Structure and Function	1/3
CH 4120	Lipids and Biomembrane Functions	1/3
CH 4130	Nucleic Acids and Bioinformation	1/3
CH 4140	Metabolism and Disease	1/3
CH 4150	Enzymology and Protein Characterization Laboratory	1/3
CH 4160	Membrane Biophysics	1/3
CH 4330	Organic Synthesis	1/3
CH 4420	Principles and Applications of Group Theory in Chemistry	1/3
CH 4520	Chemical Statistical Mechanics	1/3

Must include at least 1/3 units of chemistry (prefix CH) or 1/3 units biology (prefix BB).

Math or Basic Science (Minimum 2/3 Units)

Must include an additional 2/3 units of math or basic science (prefixes MA, PH, CH, BB, or GE).

Item #	Title	Units
BCB 4004/MA 4603	Statistical Methods in Genetics and Bioinformatics	1/3
CS 2022/MA 2201	Discrete Mathematics	1/3
CS 4032/MA 3257	Numerical Methods for Linear and Nonlinear Systems	1/3
CS 4033/MA 3457	Numerical Methods for Calculus and Differential Equations	1/3
DS 4635/MA 4635	Data Analytics and Statistical Learning	1/3
MA 1020	Calculus I with Preliminary Topics	1/3
MA 1021	Calculus I	1/3
MA 1022	Calculus II	1/3
MA 1023	Calculus III	1/3
MA 1024	Calculus IV	1/3
MA 1033	Theoretical Calculus III	1/3
MA 1034	Theoretical Calculus IV	1/3
MA 1120	Calculus II (Semester Version)	1/3
MA 1801	Denksport	1/12
MA 1971	Bridge to Higher Mathematics	1/3
MA 2051	Ordinary Differential Equations	1/3
MA 2071	Matrices and Linear Algebra I	1/3
MA 2072	Accelerated Matrices and Linear Algebra I	1/3
MA 2073	Matrices and Linear Algebra II	1/3
MA 2210	Mathematical Methods in Decision Making	1/3
MA 2211	Theory of Interest I	1/3
MA 2212	Theory of Interest II	1/3
MA 2251	Vector and Tensor Calculus	1/3
MA 2271	Graph Theory	1/3
MA 2273	Combinatorics	1/3
MA 2431	Mathematical Modeling with Ordinary Differential Equations	1/3
MA 2610	Applied Statistics for the Life Sciences	1/3
MA 2611	Applied Statistics I	1/3
MA 2612	Applied Statistics II	1/3
MA 2621	Probability for Applications	1/3
MA 2631	Probability Theory	1/3
MA 3212	Actuarial Mathematics I	1/3
MA 3213	Actuarial Mathematics II	1/3
MA 3231	Linear Programming	1/3
MA 3233	Discrete Optimization	1/3
MA 3457/CS 4033	Numerical Methods for Calculus and Differential Equations	1/3
MA 3471	Advanced Ordinary Differential Equations	1/3
MA 3475	Calculus of Variations	1/3
MA 3627	Introduction to the Design and Analysis of Experiments	1/3
MA 3631	Mathematical Statistics	1/3
MA 3823	Group Theory	1/3
MA 3825	Rings and Fields	1/3
MA 3831	Principles of Real Analysis I	1/3
MA 3832	Principles of Real Analysis II	1/3
MA 4213	Loss Models I - Risk Theory	1/3
MA 4214	Loss Models II - Survival Models	1/3
MA 4216	Actuarial Seminar	
MA 4222	Top Algorithms in Applied Mathematics	1/3
MA 4235	Mathematical Optimization	1/3
MA 4237	Probabilistic Methods in Operations Research	1/3
MA 4291	Applied Complex Variables	1/3
MA 4411	Numerical Analysis of Differential Equations	1/3
MA 4451	Boundary Value Problems	1/3

MA 4473	Partial Differential Equations	1/3
MA 4631	Probability and Mathematical Statistics I	1/3
MA 4632	Probability and Mathematical Statistics II	1/3
MA 4891	Topics in Mathematics	1/3
MA 4892	Topics in Actuarial Mathematics	1/3
MA 4895	Differential Geometry	1/3

Physics (PH) Courses

Item #	**Title**	**Units**
PH 1110	General Physics—Mechanics	1/3
PH 1111	Principles of Physics—Mechanics	1/3
PH 1120	General Physics—Electricity and Magnetism	1/3
PH 1121	Principles of Physics—Electricity and Magnetism	1/3
PH 1130	Modern Physics	1/3
PH 1140	Oscillations and Waves	1/3
PH 1150	Introductory Physics of Living Systems	1/3
PH 2101	Principles of Thermodynamics	1/3
PH 2201	Intermediate Mechanics I	1/3
PH 2202	Intermediate Mechanics II	1/3
PH 2301	Electromagnetic Fields	1/3
PH 2501	Photonics	1/3
PH 2502	Lasers	1/3
PH 2510	Atomic Force Microscopy	1/3
PH 2520	Introduction to Astrophysics	1/3
PH 2540	Solar Systems	1/3
PH 2550/AE 2550	Atmospheric and Space Environments	1/3
PH 2601	Photonics Laboratory	1/3
PH 2651	Intermediate Physics Laboratory	1/3
PH 3206	Statistical Physics	1/3
PH 3301	Electromagnetic Theory	1/3
PH 3401	Quantum Mechanics I	1/3
PH 3402	Quantum Mechanics II	1/3
PH 3501	Relativity	1/3
PH 3502	Solid State Physics	1/3
PH 3503	Nuclear Physics	1/3
PH 3504	Optics	1/3
PH 4201/PH 511	Advanced Classical Mechanics	1/3

Item #	Title	Units
BB 4170/CH 4170	Experimental Genetic Engineering	1/3
BB 4190/CH 4190	Regulation of Gene Expression	1/3
CH 1010	Chemical Properties, Bonding, and Forces	1/3
CH 1020	Chemical Reactions	1/3
CH 1030	Kinetics, Equilibrium and Thermodynamics	1/3
CH 1040	Spectroscopy in Organic and Polymer Chemistry	1/3
CH 2310	Organic Chemistry I	1/3
CH 2320	Organic Chemistry II	1/3
CH 2330	Organic Chemistry III	1/3
CH 2360	Organic Laboratory	1/3
CH 2640	Experimental Chemistry I: Instrumental Analysis	1/3
CH 2650	Modern Physical Chemistry Methods	1/3
CH 2660	Organic Synthesis and Analysis Laboratory	1/3
CH 2670	Investigation of Coordination Complexes Through Inquiry	1/3
CH 3310	Advanced Organic Chemistry	1/3
CH 3410	Structure, Bonding, and Reactivity in Inorganic Chemistry	1/3
CH 3510	Chemical Thermodynamics	1/3
CH 3530	Quantum Chemistry	1/3
CH 3550	Chemical Dynamics	1/3
CH 4110	Protein Structure and Function	1/3
CH 4120	Lipids and Biomembrane Functions	1/3
CH 4130	Nucleic Acids and Bioinformation	1/3
CH 4140	Metabolism and Disease	1/3
CH 4150	Enzymology and Protein Characterization Laboratory	1/3
CH 4160	Membrane Biophysics	1/3
CH 4330	Organic Synthesis	1/3
CH 4420	Principles and Applications of Group Theory in Chemistry	1/3
CH 4520	Chemical Statistical Mechanics	1/3

Biology and Biotechnology (BB) Courses

Item #	Title	Units
BB 1001	Introduction to Biology	1/3
BB 1002	Environmental Biology	1/3
BB 1003/BCB 1003	Exploring Bioinformatics and Computational Biology	1/3
BB 1025	Human Biology	1/3
BB 1035	Biotechnology	1/3
BB 1045	Biodiversity	1/3
BB 2002	Microbiology	1/3
BB 2003	Fundamentals of Microbiology	1/3
BB 2030	Plant Diversity	1/3
BB 2040	Principles of Ecology	1/3
BB 2050	Animal Behavior	1/3
BB 2550	Cell Biology	1/3
BB 2902	Enzymes, Proteins, and Purification	1/6
BB 2903	Anatomy and Physiology	1/6
BB 2904	Ecology, Environment, and Animal Behavior	1/6
BB 2915	Searching for Solutions in Soil: Microbial and Molecular Investigations	1/3
BB 2917	Hunting for Phage	1/3
BB 2920	Genetics	1/3
BB 2950	Molecular Biology	1/3
BB 3003	Medical Microbiology: Plagues of the Modern World, a Case Study Approach	1/3
BB 3010/BCB 3010	Simulation in Biology	1/3
BB 3050	Cancer Biology	1/3
BB 3080	Neurobiology	1/3
BB 3101	Human Anatomy & Physiology: Movement and Communication	1/3
BB 3102	Human Anatomy & Physiology: Transport and Maintenance	1/3
BB 3120	Plant Physiology	1/3
BB 3140	Evolution: Pattern and Process	1/3
BB 3512	Molecular Genetics Lab	1/6
BB 3513	Cell Culture Techniques for Animal Cells	1/6
BB 3515	Physiologic Systems Laboratory	1/3
BB 3517	Fermentation	1/6
BB 3519	Protein Purification	1/6
BB 3521	Microscopy	1/6
BB 3525	Plant Physiology	1/6
BB 3526	Phage Hunters: the Analysis	1/6
BB 3527	Molecular Biology and Genetic Engineering: Approaches and Applications	1/3
BB 3530	Immunotherapies: The Next Generation of Pharmaceuticals	1/3
BB 3570	Cell Culture Models for Tissue Regeneration	1/3
BB 3620	Developmental Biology	1/3
BB 3920	Immunology	1/3
BB 4150	Environmental Change: Problems and Approaches	1/3
BB 4170/CH 4170	Experimental Genetic Engineering	1/3
BB 4190/CH 4190	Regulation of Gene Expression	1/3
BB 4260	Synthetic Biology	1/3
BB 4801/BCB 4001	Bioinformatics	1/3
BB 4900	Capstone Experience in Biology and Biotechnology	1/3

Geosciences (GE) Courses

Item #	Title	Units
GE 2341	Geology	1/3

Engineering Science and Design (ES/D) (including the MQP) (Minimum 18/3 Units)

Because modern engineering practice is increasingly interdisciplinary, all students achieve some breadth of study outside of the ECE department by taking a minimum of one Computer Science and two Engineering Science and Design courses. These courses must be at the 2000-level or higher, and certain courses with limited technical content are not credited towards this requirement. (See the formal requirements listed previously in the distribution requirements.) Many students find it advantageous to take more than the minimum CS course requirement. CS 2301 is highly recommended for ECE students.

Electrical and Computer Engineering Area (Minimum 15/3 Units)

Must include at least 5 units at the 2000-level or higher within the Electrical and Computer Engineering area (including the MQP). All courses with prefix ECE at the 2000-level or higher and ES 3011 are applicable to these 5 units.

Must include at least 1 unit of courses from these approved Electrical Engineering courses:

Approved Electrical Engineering Courses

Item #	Title	Units
ECE 2112	Electromagnetic Fields	1/3
ECE 2201	Microelectronic Circuits I	1/3
ECE 2305	Introduction to Communications and Networks	1/3
ECE 2312	Discrete-Time Signal and System Analysis	1/3
ECE 3012	Introduction to Control Systems Engineering	1/3
ECE 3113	Introduction to RF Circuit Design	1/3
ECE 3204	Microelectronic Circuits II	1/3
ECE 3308	Introduction to Wireless Networks	1/3
ECE 3311	Principles of Communication Systems	1/3
ECE 3500	Electric Power and Renewable Energy Systems	1/3
ECE 4305	Software-Defined Radio Systems and Analysis	1/3
ECE 4503	Power Electronics And Power Management	1/3
ECE 4703	Real-Time Digital Signal Processing	1/3
ECE 4902	Analog Integrated Circuit Design	1/3
ECE 4904	Semiconductor Devices	1/3
ES 3011	Control Engineering I	1/3

Must include at least 2/3 unit of courses from these approved Computer Engineering courses:

Approved Computer Engineering Courses

Item #	Title	Units
ECE 2029	Introduction to Digital Circuit Design	1/3
ECE 2049	Embedded Computing in Engineering Design	1/3
ECE 3829	Advanced Digital System Design with FPGAs	1/3
ECE 4801	Computer Organization and Design	1/3

Must include 1/3 unit of Capstone Design Experience. (This requirement is typically fulfilled by the MQP.)

Must include at least 1/3 unit of computer science (prefix CS), at the 2000-level or above (other than CS 2011, CS 2022, CS 3043 which cannot be applied to this requirement).

2000+ Level Computer Science Courses

Item #	Title	Units
BCB 4002/CS 4802	Biovisualization	1/3
BCB 4003/CS 4803	Biological and Biomedical Database Mining	1/3
CS 2011	Introduction to Machine Organization and Assembly Language	1/3
CS 2022/MA 2201	Discrete Mathematics	1/3
CS 2102	Object-Oriented Design Concepts	1/3
CS 2103	Accelerated Object-Oriented Design Concepts	1/3
CS 2119	Application Building with Object-Oriented Concepts	1/3
CS 2223	Algorithms	1/3
CS 2301	Systems Programming for Non-Majors	1/3
CS 2303	Systems Programming Concepts	1/3
CS 3013	Operating Systems	1/3
CS 3041	Human-Computer Interaction	1/3
CS 3043	Social Implications of Information Processing	1/3
CS 3133	Foundations of Computer Science	1/3
CS 3431	Database Systems I	1/3
CS 3516	Computer Networks	1/3
CS 3733	Software Engineering	1/3
CS 4032/MA 3257	Numerical Methods for Linear and Nonlinear Systems	1/3
CS 4033/MA 3457	Numerical Methods for Calculus and Differential Equations	1/3
CS 4099	Special Topics in Computer Science	1/3
CS 4100/IMGD 4100	Artificial Intelligence for Interactive Media and Games	1/3
CS 4120	Analysis of Algorithms	1/3
CS 4123	Theory of Computation	1/3
CS 4233	Object-Oriented Analysis and Design	1/3
CS 4241	Webware: Computational Technology for Network Information Systems	1/3
CS 4300/IMGD 4300	Graphics, Simulation, and Aesthetics	1/3
CS 4341	Introduction to Artificial Intelligence	1/3
CS 4342	Machine Learning	1/3
CS 4401	Software Security Engineering	1/3
CS 4404	Tools and Techniques in Computer Network Security	1/3
CS 4432	Database Systems II	1/3
CS 4433/DS 4433	Big Data Management and Analytics	1/3
CS 4445	Data Mining and Knowledge Discovery in Databases	1/3
CS 4513	Distributed Computing Systems	1/3
CS 4515	Computer Architecture	1/3
CS 4516	Advanced Computer Networks	1/3
CS 4518	Mobile and Ubiquitous Computing	1/3
CS 4533	Techniques of Programming Language Translation	1/3
CS 4536	Programming Languages	1/3
CS 4731	Computer Graphics	1/3
CS 4732	Computer Animation	1/3
CS 4801/ECE 4802	Introduction to Cryptography and Communication Security	1/3
CS 4804	Data Visualization	1/3
MA 3457/CS 4033	Numerical Methods for Calculus and Differential Equations	1/3

Must include an additional 2/3 unit of engineering science and design at the 2000-level or above, selected from courses having the prefix AE, AREN, BME, CE, CHE, CS (other than CS 2011, CS 2022, CS 3043), ECE, ES, FP, ME, or RBE.

2000+ Level Aerospace Engineering (AE) Courses

Item #	Title	Units
AE 2110	Introduction to Incompressible Fluid Dynamics	1/3
AE 2310	Introduction to Aerospace Control Systems	1/3
AE 2320	Introduction to Orbital Mechanics	1/3
AE 2410	Introduction to Aerospace Structures	1/3
AE 3110	Fundamentals of Compressible Fluid Dynamics	1/3
AE 3120	Fundamentals of Aerodynamics	1/3
AE 3310	Fundamentals of Navigation and Communication	1/3
AE 3420	Fundamentals of Aerospace Structures	1/3
AE 3430	Fundamentals of Composite Materials	1/3
AE 4210	Fundamentals of Air-Breathing Propulsion	1/3
AE 4220	Fundamentals of Rocket Propulsion	1/3
AE 4310	Fundamentals of Aircraft Dynamics and Control	1/3
AE 4320	Fundamentals of Spacecraft Dynamics and Control	1/3
AE 4410	Fundamentals of Structural Dynamics	1/3
AE 4510	Aircraft Design	1/3
AE 4520	Spacecraft and Mission Design	1/3
PH 2550/AE 2550	Atmospheric and Space Environments	1/3

2000+ Level Architectural Engineering (AREN) Courses

Item #	Title	Units
AREN 2002	Architectural Design I	1/3
AREN 2004	Architectural Design II - Light and Lighting Systems	1/3
AREN 2023	Introduction to Architectural Engineering Systems	1/3
AREN 2025	Building Electrical Systems	1/3
AREN 3002	Architectural Design III	1/3
AREN 3003	Principles of HVAC Design for Buildings	1/3
AREN 3005	Lighting Systems	1/3
AREN 3006	Advanced HVAC System Design	1/3
AREN 3020	Architectural Design IV - Building Energy Simulation	1/3
AREN 3022	Architectural Design V - Building Envelope Design	1/3
AREN 3024	Building Physics	1/3
AREN 3025	Building Energy Simulation	1/3

2000+ Level Biomedical Engineering (BME) Courses

Item #	Title	Units
BME 2001	Introduction to Biomaterials	1/3
BME 2210	Biomedical Signals, Instruments and Measurements	1/3
BME 2211	Biomedical Data Analysis	1/3
BME 2502	Introduction to Biomechanics: Stress Analysis	1/3
BME 2610	Introduction to Bioprocess Engineering	1/3
BME 3012	Biomedical Sensors Laboratory	1/6
BME 3013	Biomedical Instrumentation Laboratory	1/6
BME 3014	Physiological Signals Laboratory I: Techniques	1/6
BME 3111	Physiology and Engineering	1/3
BME 3112	Human Physiology for Biomedical Engineers	1/3
BME 3300	Biomedical Engineering Design	1/3
BME 3503	Skeletal Biomechanics Laboratory	1/6
BME 3505	Solid Biomechanics Laboratory: Techniques	1/6
BME 3506	Solid Biomechanics Laboratory: Applications	1/6
BME 3605	Biotransport Laboratory II: Applications	1/6
BME 3610	Transport Analysis in Bioengineering	1/3
BME 3811	Biomaterials Lab	1/6
BME 3813	Cellular Engineering Lab	1/6
BME 4011/ECE 4011	Biomedical Signal Analysis	1/3
BME 4023/ECE 4023	Biomedical Instrumentation Design	1/3
BME 4201	Biomedical Imaging	1/3
BME 4300	MQP Capstone Design	1/6
BME 4503	Computational Biomechanics	1/3
BME 4504/ME 4504	Biomechanics	1/3
BME 4606/ME 4606	Biofluids	1/3
BME 4701	Cell and Molecular Bioengineering	1/3
BME 4814/ME 4814	Biomaterials	1/3
BME 4828	Biomaterials-Tissue Interactions	1/3
BME 4831	Drug Delivery	1/3

2000+ Level Civil, Engineering & Architectural Engineering (CE) Courses

Item #	Title	Units
CE 2000	Analytical Mechanics I	1/3
CE 2001	Analytical Mechanics II	1/3
CE 2002	Introduction to Analysis and Design	1/3
CE 2020	Surveying	1/3
CE 3006	Design of Steel Structures	1/3
CE 3008	Design of Reinforced Concrete Structures	1/3
CE 3010	Structural Engineering	1/3
CE 3020	Project Management	1/3
CE 3022	Legal Aspects of Professional Practice	1/3
CE 3025	Project Evaluation	1/3
CE 3026	Materials of Construction	1/3
CE 3030	Fundamentals of Civil Engineering Autocad	1/3
CE 3031	Building Information Modeling: Software Tools and Principles	1/3
CE 3041	Soil Mechanics	1/3
CE 3044	Foundation Engineering	1/3
CE 3050	Traffic Engineering	1/3
CE 3051	Pavement Engineering	1/3
CE 3059	Environmental Engineering	1/3
CE 3060	Water Treatment	1/3
CE 3061	Sustainable Wastewater Engineering: Treatment and Reuse	1/3
CE 3062	Hydraulics	1/3
CE 3070	Urban and Environmental Planning	1/3
CE 3074	Environmental Analysis	1/3
CE 4007	Matrix Analysis of Structures	1/3
CE 4060	Environmental Engineering Laboratory	1/3
CE 4061	Hydrology	1/3
CE 4063/CHE 4063	Transport & Transformations in the Environment	1/3
CE 4071	Land Use Development and Controls	1/3
CE 4600	Hazardous and Industrial Waste Management	1/3
CE 4610	Solid Waste Engineering	1/3

2000+ Level Chemical Engineering (CHE) Courses

Item #	Title	Units
CE 4063/CHE 4063	Transport & Transformations in the Environment	1/3
CHE 2011	Chemical Engineering Fundamentals	1/3
CHE 2012	Elementary Chemical Processes	1/3
CHE 2013	Applied Chemical Engineering Thermodynamics	1/3
CHE 2014	Advanced Chemical Processes	1/3
CHE 3201	Kinetics and Reactor Design	1/3
CHE 3301	Introduction to Biological Engineering	1/3
CHE 3501	Applied Mathematics in Chemical Engineering	1/3
CHE 3702	Energy Challenges in the 21st Century	1/3
CHE 3722	Bioenergy	1/3
CHE 4401	Unit Operations of Chemical Engineering I	1/3
CHE 4402	Unit Operations of Chemical Engineering II	1/3
CHE 4403	Chemical Engineering Design	1/3
CHE 4404	Chemical Plant Design Project	1/3
CHE 4405	Chemical Process Dynamics and Control Laboratory	1/3
CHE 4410	Chemical Process Safety Design	1/3

Item #	Title	Units
BCB 4002/CS 4802	Biovisualization	1/3
BCB 4003/CS 4803	Biological and Biomedical Database Mining	1/3
CS 2011	Introduction to Machine Organization and Assembly Language	1/3
CS 2022/MA 2201	Discrete Mathematics	1/3
CS 2102	Object-Oriented Design Concepts	1/3
CS 2103	Accelerated Object-Oriented Design Concepts	1/3
CS 2119	Application Building with Object-Oriented Concepts	1/3
CS 2223	Algorithms	1/3
CS 2301	Systems Programming for Non-Majors	1/3
CS 2303	Systems Programming Concepts	1/3
CS 3013	Operating Systems	1/3
CS 3041	Human-Computer Interaction	1/3
CS 3043	Social Implications of Information Processing	1/3
CS 3133	Foundations of Computer Science	1/3
CS 3431	Database Systems I	1/3
CS 3516	Computer Networks	1/3
CS 3733	Software Engineering	1/3
CS 4032/MA 3257	Numerical Methods for Linear and Nonlinear Systems	1/3
CS 4033/MA 3457	Numerical Methods for Calculus and Differential Equations	1/3
CS 4099	Special Topics in Computer Science	1/3
CS 4100/IMGD 4100	Artificial Intelligence for Interactive Media and Games	1/3
CS 4120	Analysis of Algorithms	1/3
CS 4123	Theory of Computation	1/3
CS 4233	Object-Oriented Analysis and Design	1/3
CS 4241	Webware: Computational Technology for Network Information Systems	1/3
CS 4300/IMGD 4300	Graphics, Simulation, and Aesthetics	1/3
CS 4341	Introduction to Artificial Intelligence	1/3
CS 4342	Machine Learning	1/3
CS 4401	Software Security Engineering	1/3
CS 4404	Tools and Techniques in Computer Network Security	1/3
CS 4432	Database Systems II	1/3
CS 4433/DS 4433	Big Data Management and Analytics	1/3
CS 4445	Data Mining and Knowledge Discovery in Databases	1/3
CS 4513	Distributed Computing Systems	1/3
CS 4515	Computer Architecture	1/3
CS 4516	Advanced Computer Networks	1/3
CS 4518	Mobile and Ubiquitous Computing	1/3
CS 4533	Techniques of Programming Language Translation	1/3
CS 4536	Programming Languages	1/3
CS 4731	Computer Graphics	1/3
CS 4732	Computer Animation	1/3
CS 4801/ECE 4802	Introduction to Cryptography and Communication Security	1/3
CS 4804	Data Visualization	1/3
MA 3457/CS 4033	Numerical Methods for Calculus and Differential Equations	1/3

2000+ Level Electrical and Computer Engineering (ECE) Courses

Item #	Title	Units
BME 4011/ECE 4011	Biomedical Signal Analysis	1/3
BME 4023/ECE 4023	Biomedical Instrumentation Design	1/3
CS 4801/ECE 4802	Introduction to Cryptography and Communication Security	1/3
ECE 2010	Introduction to Electrical and Computer Engineering	1/3
ECE 2019	Sensors, Circuits, and Systems	1/3
ECE 2029	Introduction to Digital Circuit Design	1/3
ECE 2049	Embedded Computing in Engineering Design	1/3
ECE 2112	Electromagnetic Fields	1/3
ECE 2201	Microelectronic Circuits I	1/3
ECE 2305	Introduction to Communications and Networks	1/3
ECE 2311	Continuous-Time Signal and System Analysis	1/3
ECE 2312	Discrete-Time Signal and System Analysis	1/3
ECE 2799	Electrical and Computer Engineering Design	1/3
ECE 3012	Introduction to Control Systems Engineering	1/3
ECE 3113	Introduction to RF Circuit Design	1/3
ECE 3204	Microelectronic Circuits II	1/3
ECE 3308	Introduction to Wireless Networks	1/3
ECE 3311	Principles of Communication Systems	1/3
ECE 3500	Electric Power and Renewable Energy Systems	1/3
ECE 3501	Electromechanical Energy Systems	1/3
ECE 3829	Advanced Digital System Design with FPGAs	1/3
ECE 3849	Real-Time Embedded Systems	1/3
ECE 4305	Software-Defined Radio Systems and Analysis	1/3
ECE 4503	Power Electronics And Power Management	1/3
ECE 4703	Real-Time Digital Signal Processing	1/3
ECE 4801	Computer Organization and Design	1/3
ECE 4902	Analog Integrated Circuit Design	1/3
ECE 4904	Semiconductor Devices	1/3

2000+ Level Engineering Science Interdisciplinary (ES) Courses

Item #	Title	Units
ES 2001	Introduction to Materials Science	1/3
ES 2501	Introduction to Static Systems	1/3
ES 2502	Stress Analysis	1/3
ES 2503	Introduction to Dynamic Systems	1/3
ES 2800	Environmental Impacts of Engineering Decisions	1/3
ES 3001	Introduction to Thermodynamics	1/3
ES 3002	Mass Transfer	1/3
ES 3003	Heat Transfer	1/3
ES 3004	Fluid Mechanics	1/3
ES 3011	Control Engineering I	1/3
ES 3323	Advanced Computer Aided Design	1/3
ES 3501	A Project-Based Introduction to Systems Engineering	1/3

2000+ Level Fire Protection Engineering (FP) Courses

Item #	Title	Units
FP 3070	Introduction to Fire Protection Engineering	1/3
FP 3080	Introduction to Building Fires Safety System Design	1/3
FP 4000	Fire Laboratory	1/3
FP 4001	Fire, Risk, and Sustainability	1/3

2000+ Level Mechanical and Materials Engineering (ME) Courses

Item #	Title	Units
BME 4504/ME 4504	Biomechanics	1/3
BME 4606/ME 4606	Biofluids	1/3
BME 4814/ME 4814	Biomaterials	1/3
ME 2300	Introduction to Engineering Design	1/3
ME 2312	Introduction to Computational Solutions for Engineering Problems	1/3
ME 2820	Materials Processing	1/3
ME 3310	Kinematics of Mechanisms	1/3
ME 3311	Dynamics of Mechanisms and Machines	1/3
ME 3320	Design of Machine Elements	1/3
ME 3411	Intermediate Fluid Mechanics	1/3
ME 3501	Elementary Continuum Mechanics	1/3
ME 3506	Rehabilitation Engineering	1/3
ME 3820	Computer-Aided Manufacturing	1/3
ME 3901	Engineering Experimentation	1/3
ME 3902	Project-Based Engineering Experimentation	1/3
ME 4320	Advanced Engineering Design	1/3
ME 4323	Fundamentals of Drivetrain Systems	1/3
ME 4324	Integrated Design of Mechanical Systems	1/3
ME 4422	Design and Optimization of Thermal Systems	1/3
ME 4424	Radiation Heat Transfer Application and Design	1/3
ME 4429	Thermofluid Application and Design	1/3
ME 4430	Integrated Thermomechanical Design and Analysis	1/3
ME 4505	Advanced Dynamics	1/3
ME 4506	Mechanical Vibrations	1/3
ME 4512	Introduction to the Finite Element Method	1/3
ME 4710	Gas Turbines for Propulsion and Power Generation	1/3
ME 4813	Ceramics and Glasses for Engineering Applications	1/3
ME 4821	Plastics	1/3
ME 4832	Corrosion and Corrosion Control	1/3
ME 4840	Physical Metallurgy	1/3
ME 4875/MTE 575	Introduction to Nanomaterials and Nanotechnology	1/3
RBE 4322/ME 4322	Modeling and Analysis of Mechatronic Systems	1/3

2000+ Level Robotics Engineering (RBE) Courses

Item #	Title	Units
RBE 2001	Unified Robotics I: Actuation	1/3
RBE 2002	Unified Robotics II: Sensing	1/3
RBE 3001	Unified Robotics III: Manipulation	1/3
RBE 3002	Unified Robotics IV: Navigation	1/3
RBE 3100	Social Implications of Robotics	1/3
RBE 4322/ME 4322	Modeling and Analysis of Mechatronic Systems	1/3
RBE 4540	Vision-based Robotic Manipulation	1/3
RBE 4815	Industrial Robotics	1/3

Subdisciplines Within ECE

Given a solid foundation, the MQP will allow you to demonstrate an in-depth understanding of one or more of the subdisciplines that compose the field of electrical and computer engineering. As a guide to the areas of study that can be investigated in an MQP, the ECE Course Flowchart identifies seven subdisciplines as possible areas for in-depth study leading to an MQP. Note that students should not feel constrained by these area designations — this is only one of many possible ways to organize the diverse field of electrical and computer engineering. Many if not most MQPs will incorporate subject matter from several different subdisciplines. The purpose of this list is to guide students interested in a particular area to coursework within a subdiscipline (Area Courses), relevant courses to choose from outside the subdiscipline (Related Courses), and faculty whose research and MQP advising interests fall within the subdiscipline (Area Consultants).

Robotics

Area Consultants: Michalson, Wyglinski

Area Courses

Item #	Title	Units
ECE 2029	Introduction to Digital Circuit Design	1/3
ECE 2049	Embedded Computing in Engineering Design	1/3
ECE 3849	Real-Time Embedded Systems	1/3
ES 3011	Control Engineering I	1/3

Related Courses

Item #	Title	Units
CS 4341	Introduction to Artificial Intelligence	1/3
ECE 2201	Microelectronic Circuits I	1/3
RBE 1001	Introduction to Robotics	1/3
RBE 2001	Unified Robotics I: Actuation	1/3
RBE 2002	Unified Robotics II: Sensing	1/3
RBE 3001	Unified Robotics III: Manipulation	1/3
RBE 3002	Unified Robotics IV: Navigation	1/3

Power Systems Engineering

Area Consultants: Noetscher

Area Courses

Item #	Title	Units
ECE 3500	Electric Power and Renewable Energy Systems	1/3
ECE 3501	Electromechanical Energy Systems	1/3
ECE 4503	Power Electronics And Power Management	1/3

Related Courses

Item #	Title	Units
ES 3001	Introduction to Thermodynamics	1/3
ES 3011	Control Engineering I	1/3
ME 1800	Manufacturing Science, Prototyping, and Computer-Controlled Machining	1/3
OIE 2850	Engineering Economics	1/3

RF Circuits and Microwaves

Area Consultants: Ludwig, Makaroff

Area Courses

Item #	Title	Units
ECE 2112	Electromagnetic Fields	1/3
ECE 3113	Introduction to RF Circuit Design	1/3

Related Courses

Item #	Title	Units
MA 4451	Boundary Value Problems	1/3
PH 3301	Electromagnetic Theory	1/3

Communications and Signal Analysis

Area Consultants: Brown, Clancy, Makaroff, Pahlavan, Tang, Wyglinski

Area Courses

Item #	Title	Units
ECE 2305	Introduction to Communications and Networks	1/3
ECE 2312	Discrete-Time Signal and System Analysis	1/3
ECE 3308	Introduction to Wireless Networks	1/3
ECE 3311	Principles of Communication Systems	1/3
ECE 4305	Software-Defined Radio Systems and Analysis	1/3
ECE 4703	Real-Time Digital Signal Processing	1/3

Related Courses

Item #	Title	Units
ES 3011	Control Engineering I	1/3
MA 2071	Matrices and Linear Algebra I	1/3
MA 2621	Probability for Applications	1/3
MA 4291	Applied Complex Variables	1/3

Biomedical Engineering

Area Consultants: Clancy

Area Courses

Item #	Title	Units
BME 4011/ECE 4011	Biomedical Signal Analysis	1/3
BME 4023/ECE 4023	Biomedical Instrumentation Design	1/3

Related Courses

Item #	Title	Units
BME 4201	Biomedical Imaging	1/3
ECE 2201	Microelectronic Circuits I	1/3
ECE 2312	Discrete-Time Signal and System Analysis	1/3
ECE 3204	Microelectronic Circuits II	1/3

Analog Microelectronics

Area Consultants: Bitar, Guler, Ludwig

Area Courses

Item #	Title	Units
ECE 2201	Microelectronic Circuits I	1/3
ECE 3204	Microelectronic Circuits II	1/3
ECE 4902	Analog Integrated Circuit Design	1/3
ECE 4904	Semiconductor Devices	1/3

Related Courses

Item #	Title	Units
ES 3011	Control Engineering I	1/3

Computer Engineering

Area Consultants:Clancy, Huang, Michalson, Sunar

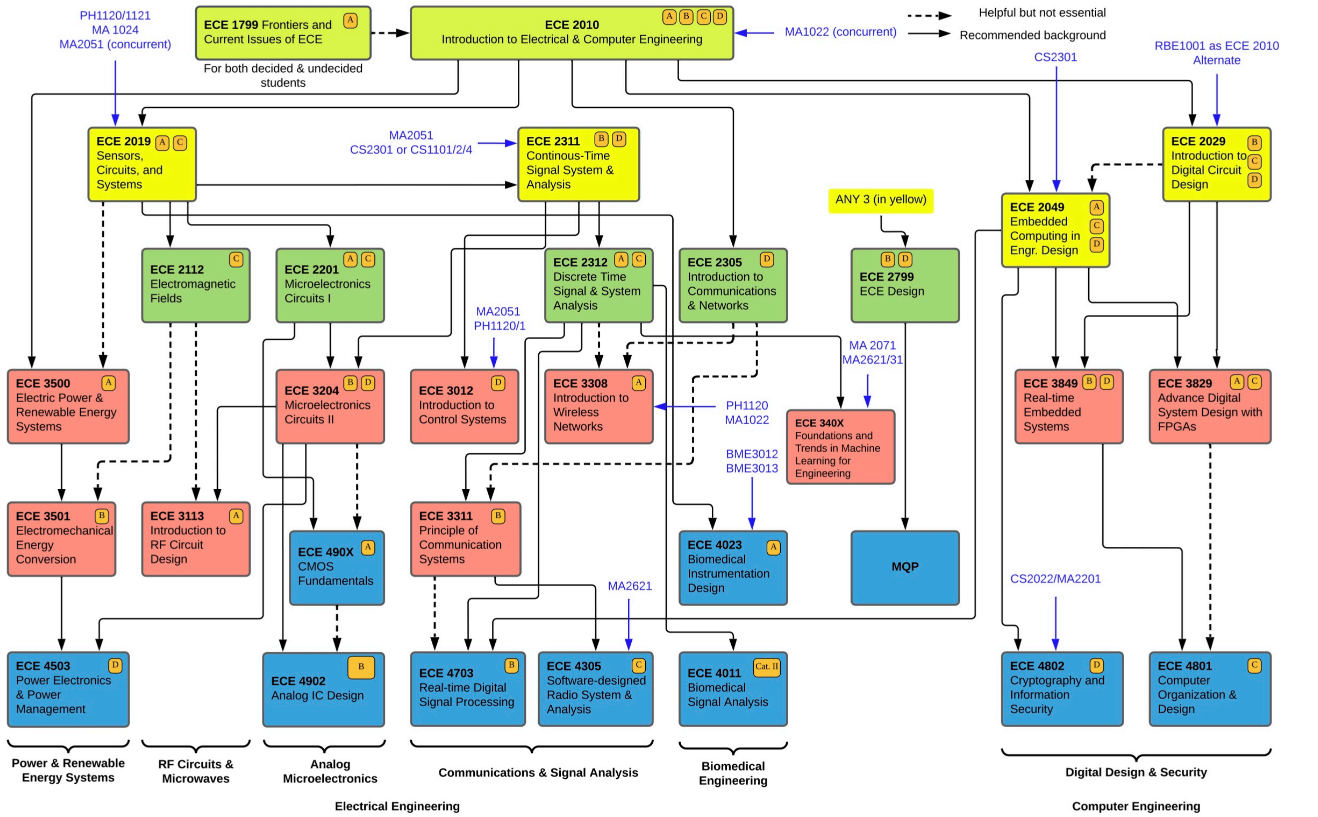
Area Courses

Item #	Title	Units
ECE 2029	Introduction to Digital Circuit Design	1/3
ECE 2049	Embedded Computing in Engineering Design	1/3
ECE 3829	Advanced Digital System Design with FPGAs	1/3
ECE 3849	Real-Time Embedded Systems	1/3
ECE 4801	Computer Organization and Design	1/3

Related Courses

Item #	Title	Units
CS 2223	Algorithms	1/3
CS 3013	Operating Systems	1/3
CS 4515	Computer Architecture	1/3
CS 4536	Programming Languages	1/3
ECE 2201	Microelectronic Circuits I	1/3

Program Chart and/or Course Flow Chart



Electrical and Computer Engineering Minor

Degree Type

Minor

For students who are not ECE majors and are interested in broadening their exposure to and understanding of electrical and computer engineering, the ECE department offers a Minor. This Minor provides an exciting opportunity to acquire a solid knowledge of electrical and computer engineering as needed in today's diverse and technology driven society.

The ECE minor form, available in the ECE office, lists examples of thematically related courses in different areas of concentration. Students seeking an ECE Minor should complete the ECE Minor form and submit it to the ECE office as early in the program of study as possible. The chair of the ECE curriculum committee will be responsible for review and approval of all ECE Minor requests.

WPI policy requires that no more than one unit of course work can be double counted toward other degree requirements.

Successful candidates for the ECE Minor must meet the following requirements:

Program Distribution Requirements for the Minor in Electrical and Computer Engineering

Electrical and Computer Engineering Coursework (Minimum 6/3 Units)

Students pursuing the Minor in Electrical and Computer Engineering must complete two units of work from courses with the prefix "ECE" at the 2000-level or above.

Of this work, at least 2/3 unit must be from ECE courses at the 3000-level or above which are thematically related.

2000 Level Electrical and Computer Engineering (ECE) Courses

Item #	Title	Units
ECE 2010	Introduction to Electrical and Computer Engineering	1/3
ECE 2019	Sensors, Circuits, and Systems	1/3
ECE 2029	Introduction to Digital Circuit Design	1/3
ECE 2049	Embedded Computing in Engineering Design	1/3
ECE 2112	Electromagnetic Fields	1/3
ECE 2201	Microelectronic Circuits I	1/3
ECE 2305	Introduction to Communications and Networks	1/3
ECE 2311	Continuous-Time Signal and System Analysis	1/3
ECE 2312	Discrete-Time Signal and System Analysis	1/3
ECE 2799	Electrical and Computer Engineering Design	1/3

3000 Level Electrical and Computer Engineering (ECE) Courses

Item #	Title	Units
ECE 3012	Introduction to Control Systems Engineering	1/3
ECE 3113	Introduction to RF Circuit Design	1/3
ECE 3204	Microelectronic Circuits II	1/3
ECE 3308	Introduction to Wireless Networks	1/3
ECE 3311	Principles of Communication Systems	1/3
ECE 3500	Electric Power and Renewable Energy Systems	1/3
ECE 3501	Electromechanical Energy Systems	1/3
ECE 3829	Advanced Digital System Design with FPGAs	1/3
ECE 3849	Real-Time Embedded Systems	1/3

4000 Level Electrical and Computer Engineering (ECE) Courses

Item #	Title	Units
BME 4011/ECE 4011	Biomedical Signal Analysis	1/3
BME 4023/ECE 4023	Biomedical Instrumentation Design	1/3
CS 4801/ECE 4802	Introduction to Cryptography and Communication Security	1/3
ECE 4305	Software-Defined Radio Systems and Analysis	1/3
ECE 4503	Power Electronics And Power Management	1/3
ECE 4703	Real-Time Digital Signal Processing	1/3
ECE 4801	Computer Organization and Design	1/3
ECE 4902	Analog Integrated Circuit Design	1/3
ECE 4904	Semiconductor Devices	1/3

Fire Protection Engineering

A. SIMEONI, DEPARTMENT HEAD

PROFESSORS: N. A. Dembsey, A. Rangwala, A. Simeoni

ASSOCIATE PROFESSOR: K. A. Notarianni

ASSISTANT PROFESSOR: J.L. Urban

PROFESSOR OF PRACTICE: M. Puchovsky, Associate Department Head

ADJUNCT FPE FACULTY: W. Krein, C. Wood, R. Solomon

EMERITUS PROFESSORS: R. W. Fitzgerald, D. A. Lucht

ASSOCIATED FACULTY: L. Albano (CEE), J. Liang (ME)

Mission Statement

The fire protection engineering department seeks to expand the knowledge and training of WPI graduates from different engineering disciplines so they can apply these skills in their disciplines or pursue advanced training through the Fire Protection Engineering BS/MS program. The department seeks to cultivate a nexus of fire protection engineering knowledge, training, and research with students and researchers from diverse STEM fields.

Program Educational Objectives

- To enhance the education of undergraduate STEM students with Fire Protection Engineering knowledge and skills through an undergraduate minor program to apply to their main disciplines (undergraduate majors).
- To train undergraduate STEM students from other disciplines for advanced study through the BS/MS program.

Combined BS/MS Degree Program

A combined-degree program is available for those undergraduate students having a strong interest in fire protection. This program provides students with the opportunity to accelerate their graduate work by careful development of their undergraduate plan of study leading to a Bachelor degree in a field of engineering and a master's degree in fire protection engineering. The combined-degree approach saves time and money since up to 40 percent of course credits counted towards the Master's degree can also be counted toward the Bachelor degree. Holders of a Bachelor degree in traditional engineering or science disciplines and the Master's degree in fire protection engineering enjoy extremely good versatility in the job market.

Fire Protection Engineering

Five-Year Program

High school seniors can be admitted to the combined-degree program as first-year students, allowing them to complete both a bachelor's degree in a selected field of engineering followed by the master's degree in fire protection engineering, in a total of five years.

Fire Protection Engineering Minor

Degree Type

Minor

The FPE department is offering a minor for students who want to expand their engineering background by being exposed to Fire Protection Engineering at undergraduate level. The minor in Fire Protection Engineering provides an excellent opportunity to acquire a basic knowledge in Fire Protection and articulate this knowledge with their own major in an omnipresent and growing field of engineering that offers exciting careers.

Successful candidates for the FPE Minor must meet the following requirements:

Program Distribution Requirements for the Fire Protection Engineering Minor

Fire Protection Engineering Coursework (Minimum 6/3 Units)

Complete two units of work, including at least 1 unit with the prefix "FP" at the 3000-level or above.

3000 Level Fire Protection Engineering Courses

Item #	Title	Units
FP 3070	Introduction to Fire Protection Engineering	1/3
FP 3080	Introduction to Building Fires Safety System Design	1/3

4000 Level Fire Protection Engineering Courses

Item #	Title	Units
FP 4000	Fire Laboratory	1/3
FP 4001	Fire, Risk, and Sustainability	1/3

The remaining courses can be chosen from the following list:

Additional Courses for the Fire Protection Engineering Minor

Item #	Title	Units
AE 2110	Introduction to Incompressible Fluid Dynamics	1/3
CE 3006	Design of Steel Structures	1/3
CE 3008	Design of Reinforced Concrete Structures	1/3
CE 3010	Structural Engineering	1/3
CE 3031	Building Information Modeling: Software Tools and Principles	1/3
CHE 2013	Applied Chemical Engineering Thermodynamics	1/3
CHE 4410	Chemical Process Safety Design	1/3
ES 3001	Introduction to Thermodynamics	1/3
ES 3003	Heat Transfer	1/3

Robotics Engineering

Department Head: J. XIAO

ASSOCIATE HEAD: G. C. LEWIN

PROFESSORS: G. Fischer, W. R. Michalson, J. Xiao

ASSOCIATE PROFESSOR: C.D. Onal, C. Pinciroli

ASSISTANT PROFESSORS: B. Calli, C. Chamzas, L. Fichera, K. Leahy, Z. Li, M. Nemitz, H. Zhang

ASSISTANT RESEARCH PROFESSOR: C. Nycz

ASSISTANT TEACHING PROFESSORS: M. Agheli, V. Aloi, G. C. Lewin

SENIOR INSTRUCTOR: N. Bertozzi

ADJUNCT FACULTY: D. Flickinger, S. Ghorbani Faal, R. Hammoud, N. Hata, J. Nafziger, W. L. Rasmussen, A. Sinha, K.A. Stafford, A. Tatoglu, S. H. Zhang

ASSOCIATED FACULTY: E. O. Agu (CS), S. Barton (HUA), C. A. Brown (ME), S. Farzan, C. Furlong (ME), G. R. Gaudette (BME), J. Fu, X. Huang (ECE), D. Korkin (CS), Y. S. Liu (ME), P. Radhakrishnan (ME), C. L. Sidner (CS), J. Skorinko (SSPS), E. Solovey (CS), J. Stabile (ME), A. Wyglinski (ECE), Z. Zhang (ECE), Y. Zheng (ME)

FACULTY EMERITUS: D. Cyganski, M. A. Gennert, F. J. Looft, K.A. Stafford

Mission Statement

Robotics combines sensing, computation, and actuation in the real world, defined as intelligent connection from perception to action. Intelligent robotics is playing a key role in the fourth industrial revolution as it fuses technologies that connect physical, digital, biological, and social spheres. Robotics is becoming omnipresent in serving societal needs, with wide-range applications, including medicine and healthcare, transportation, manufacturing, material handling, exploration in space and deep sea, defense, domestic help, search and rescue, and emergency responses.

Program Educational Objectives

Graduates of the Robotics Engineering program are expected to:

1. Successfully:
   1. attain professional careers in robotics and related industries, academia, and government;
   2. expand human knowledge through research and development; and/or
   3. develop entrepreneurial engineering activities.
2. Engage in life-long and continuous learning, including advanced degrees.
3. Exert leadership over multi-disciplinary projects and teams.
4. Contribute as responsible professionals through community service, mentoring, instructing, and guiding their professions in ethical directions.
5. Communicate effectively to professional and business colleagues, and the public.

STUDENT OUTCOMES

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors

3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies
8. an ability to evaluate and integrate the mechanical, electrical, and computational components of a cyber-physical system.
9. an ability to recognize and take advantage of entrepreneurial opportunities.

Robotics Engineering Major

Degree Type

Bachelor of Science

Mathematics (Minimum 7/3 Units)

Must include Differential and Integral Calculus, Differential Equations, Linear Algebra, and Probability.

Basic Science (Minimum 4/3 Units)

Must include at least 2/3 units in Physics.

Entrepreneurship (Minimum 1/3 Units)

Social Implications (Minimum 1/3 Units)

Must include at least 1/3 unit of Social Implications of Technology (CS 3043, GOV 2302, GOV/ID 2314 or RBE 3100). If GOV 2302 or GOV/ID 2314 are double-counted as meeting the Social Science Requirement and the Social Implications Requirement, then the Distribution Requirements total 10 units, otherwise the Distribution Requirements total 10 1/3 units.

Engineering Science and Design, including the MQP (Minimum 18/3 Units)

Must include at least 5/3 units in Robotics Engineering, including RBE 2001, RBE 2002, RBE 3001, and RBE 3002, or equivalent. RBE 3100 may not be used to fulfill this requirement. Must include at least 1 unit in Computer Science, including Object-Oriented Programming and Software Engineering. Must include at least 2/3 units in Electrical and Computer Engineering, including Embedded Systems. Must include at least 1/3 unit in Statics and 1/3 unit in Classical Controls (ES 3011, ECE 3012, AE 2310, or equivalent). RBE 502 cannot satisfy this requirement. Must include at least 1 unit of Engineering Science and Design Electives, of which at least 2/3 unit must be at the 4000-level or higher. The MQP must be a Capstone Design Experience in Robotics Engineering.

Item #	Title	Units
RBE 1001	Introduction to Robotics	1/3
RBE 2001	Unified Robotics I: Actuation	1/3
RBE 2002	Unified Robotics II: Sensing	1/3
RBE 3001	Unified Robotics III: Manipulation	1/3
RBE 3002	Unified Robotics IV: Navigation	1/3
RBE 3100	Social Implications of Robotics	1/3
RBE 4322/ME 4322	Modeling and Analysis of Mechatronic Systems	1/3
RBE 4540	Vision-based Robotic Manipulation	1/3
RBE 4815	Industrial Robotics	1/3

Item #	Title	Units
BCB 4002/CS 4802	Biovisualization	1/3
BCB 4003/CS 4803	Biological and Biomedical Database Mining	1/3
CS 1004	Introduction to Programming for Non-Majors	1/3
CS 1101	Introduction to Program Design	1/3
CS 1102	Accelerated Introduction to Program Design	1/3
CS 2011	Introduction to Machine Organization and Assembly Language	1/3
CS 2022/MA 2201	Discrete Mathematics	1/3
CS 2102	Object-Oriented Design Concepts	1/3
CS 2103	Accelerated Object-Oriented Design Concepts	1/3
CS 2119	Application Building with Object-Oriented Concepts	1/3
CS 2223	Algorithms	1/3
CS 2301	Systems Programming for Non-Majors	1/3
CS 2303	Systems Programming Concepts	1/3
CS 3013	Operating Systems	1/3
CS 3041	Human-Computer Interaction	1/3
CS 3043	Social Implications of Information Processing	1/3
CS 3133	Foundations of Computer Science	1/3
CS 3431	Database Systems I	1/3
CS 3516	Computer Networks	1/3
CS 3733	Software Engineering	1/3
CS 4032/MA 3257	Numerical Methods for Linear and Nonlinear Systems	1/3
CS 4033/MA 3457	Numerical Methods for Calculus and Differential Equations	1/3
CS 4099	Special Topics in Computer Science	1/3
CS 4100/IMGD 4100	Artificial Intelligence for Interactive Media and Games	1/3
CS 4120	Analysis of Algorithms	1/3
CS 4123	Theory of Computation	1/3
CS 4233	Object-Oriented Analysis and Design	1/3
CS 4241	Webware: Computational Technology for Network Information Systems	1/3
CS 4300/IMGD 4300	Graphics, Simulation, and Aesthetics	1/3
CS 4341	Introduction to Artificial Intelligence	1/3
CS 4342	Machine Learning	1/3
CS 4401	Software Security Engineering	1/3
CS 4404	Tools and Techniques in Computer Network Security	1/3
CS 4432	Database Systems II	1/3
CS 4433/DS 4433	Big Data Management and Analytics	1/3
CS 4445	Data Mining and Knowledge Discovery in Databases	1/3
CS 4513	Distributed Computing Systems	1/3
CS 4515	Computer Architecture	1/3
CS 4516	Advanced Computer Networks	1/3
CS 4518	Mobile and Ubiquitous Computing	1/3
CS 4533	Techniques of Programming Language Translation	1/3
CS 4536	Programming Languages	1/3
CS 4731	Computer Graphics	1/3
CS 4732	Computer Animation	1/3
CS 4801/ECE 4802	Introduction to Cryptography and Communication Security	1/3
CS 4804	Data Visualization	1/3
MA 3457/CS 4033	Numerical Methods for Calculus and Differential Equations	1/3

Electrical and Computer Engineering

Item #	Title	Units
BME 4011/ECE 4011	Biomedical Signal Analysis	1/3
BME 4023/ECE 4023	Biomedical Instrumentation Design	1/3
CS 4801/ECE 4802	Introduction to Cryptography and Communication Security	1/3
ECE 1799	Frontiers and Current Issues of Electrical and Computer Engineering	1/6
ECE 2010	Introduction to Electrical and Computer Engineering	1/3
ECE 2019	Sensors, Circuits, and Systems	1/3
ECE 2029	Introduction to Digital Circuit Design	1/3
ECE 2049	Embedded Computing in Engineering Design	1/3
ECE 2112	Electromagnetic Fields	1/3
ECE 2201	Microelectronic Circuits I	1/3
ECE 2305	Introduction to Communications and Networks	1/3
ECE 2311	Continuous-Time Signal and System Analysis	1/3
ECE 2312	Discrete-Time Signal and System Analysis	1/3
ECE 2799	Electrical and Computer Engineering Design	1/3
ECE 3012	Introduction to Control Systems Engineering	1/3
ECE 3113	Introduction to RF Circuit Design	1/3
ECE 3204	Microelectronic Circuits II	1/3
ECE 3308	Introduction to Wireless Networks	1/3
ECE 3311	Principles of Communication Systems	1/3
ECE 3500	Electric Power and Renewable Energy Systems	1/3
ECE 3501	Electromechanical Energy Systems	1/3
ECE 3829	Advanced Digital System Design with FPGAs	1/3
ECE 3849	Real-Time Embedded Systems	1/3
ECE 4305	Software-Defined Radio Systems and Analysis	1/3
ECE 4503	Power Electronics And Power Management	1/3
ECE 4703	Real-Time Digital Signal Processing	1/3
ECE 4801	Computer Organization and Design	1/3
ECE 4902	Analog Integrated Circuit Design	1/3
ECE 4904	Semiconductor Devices	1/3

Statics

Classical Controls

Engineering Science and Design Electives

Major Qualifying Projects

Robotics Engineering MQPs are capstone design activities that span a wide range of topics from autonomous ground/air/underwater vehicles to swarm robotics to human-robot interaction, with applications in surgery, inspection, manufacturing, security, and entertainment, to name but a few. All RBE MQPs must go through the breadth of the design experience, including conceptualization, requirements, design, implementation, evaluation, and documentation. Projects also address societal issues, including professional responsibility, ethical and environmental considerations, sustainability, aesthetics, and safety. RBE MQPs may be sponsored by industry, including the Lincoln Lab and Silicon Valley project centers, develop from faculty research, or be initiated by students. Please see the Robotics Engineering website http://robotics.wpi.edu/ for information on current projects.

Additional Advice

For additional advice about course selections, including elective choices, students should consult with their academic advisor.

Robotics Engineering Minor

Degree Type

Minor

No more than 1 unit of work may overlap the major. Students considering a Robotics Engineering Minor should consult with the RBE Undergraduate Program Committee.

Program Distribution Requirements for the Robotics Engineering Minor

The Minor in Robotics Engineering consists of 2 units of work distributed as follows:

Computer Science (Minimum 1/3 Units)

Students must complete 1/3 unit Computer Science (CS) selected from the following list:

Computer Science Courses

Item #	Title	Units
CS 2102	Object-Oriented Design Concepts	1/3
CS 2103	Accelerated Object-Oriented Design Concepts	1/3
CS 2223	Algorithms	1/3
CS 2301	Systems Programming for Non-Majors	1/3
CS 2303	Systems Programming Concepts	1/3
CS 3733	Software Engineering	1/3

Electrical and Computer Engineering (Minimum 1/3 Units)

Students must complete 1/3 unit of Electrical and Computer Engineering (ECE) courses selected from the following list:

Electrical and Computer Engineering Courses

Item #	Title	Units
ECE 2010	Introduction to Electrical and Computer Engineering	1/3
ECE 2019	Sensors, Circuits, and Systems	1/3
ECE 2029	Introduction to Digital Circuit Design	1/3
ECE 2049	Embedded Computing in Engineering Design	1/3
ECE 2311	Continuous-Time Signal and System Analysis	1/3

Mechanical and Materials Engineering/Engineering Science Interdisciplinary (Minimum 1/3 Units)

Students must complete 1/3 unit Mechanical and Materials Engineering (ME) or Engineering Science Interdisciplinary (ES) selected from the following list:

Mechanical and Materials Engineering/Engineering Science Interdisciplinary Courses

Item #	Title	Units
ES 2501	Introduction to Static Systems	1/3
ES 2503	Introduction to Dynamic Systems	1/3
ES 3011	Control Engineering I	1/3
ME 3310	Kinematics of Mechanisms	1/3

Robotics Engineering (Minimum 2/3 Units)

Students must complete 2/3 units selected from the following list:

Robotics Engineering Courses

Item #	Title	Units
RBE 1001	Introduction to Robotics	1/3
RBE 2001	Unified Robotics I: Actuation	1/3
RBE 2002	Unified Robotics II: Sensing	1/3

Capstone Experience (Minimum 1/3 Units)

A 1/3 unit capstone experience through an RBE course at 3000-level or above.

3000+ Level Robotics Engineering Courses

Item #	Title	Units
RBE 3001	Unified Robotics III: Manipulation	1/3
RBE 3002	Unified Robotics IV: Navigation	1/3
RBE 4322/ME 4322	Modeling and Analysis of Mechatronic Systems	1/3
RBE 4815	Industrial Robotics	1/3

Integrative & Global Studies

Associate Dean, Global School: K. J. Rissmiller

PROFESSORS: L. Elgert, S. Strauss, R. F. Vaz (Emeritus), K. Wobbe

ASSOCIATE PROFESSORS: S. Jiusto, K.J. Rissmiller, S. Tuler

ASSISTANT PROFESSORS: T. Masvawure, W. San Martin, S. Stanlick

ASSOCIATE PROFESSORS OF TEACHING: G. Burrier, C. Dehner, S. McCauley, G. Pfeifer, D. Rosbach, E.A. Stoddard

ASSISTANT PROFESSORS OF TEACHING: J. M. Davis, Z. Eddy, K. Foo, C. Kurlanska

TEACHING PROFESSORS: F. Carrera, D. Golding, I. Shockey

ASSOCIATE TEACHING PROFESSORS: M. Bakermans, M. Belz, L. Dodson, L. Higgins

ASSISTANT TEACHING PROFESSORS:, J. Doiron, L. Roberts. J. Sphar

INSTRUCTORS/LECTURERS: M. Butler, J. Chiarelli, R. Hersh

In addition to overseeing the Interactive Qualifying Project (see page 18) and the Global Projects Program (see page 19), the Interdisciplinary and Global Studies Division (IGSD) provides the support structure for students who construct individually-designed (ID) majors which cannot readily be accommodated in traditional academic departments.

ID majors may be defined in any area of study where WPI's academic strengths can support a program of study, and in which career goals exist. Many combinations of technical and non-technical study are possible. Do not be limited by the example given here; if you have questions about what programs at WPI are possible, please see Dean Kent Rissmiller in the FIS to discuss how WPI can assist you in reaching your goals.

Interdisciplinary (Individually Designed) Major

Degree Type
Bachelor of Arts/Sciences

Students who wish to pursue an individually-designed major program should first discuss their ideas with their academic advisor. The student should then consult with the associate dean of The Global School, who will determine, with the assistance of other members of the faculty, if the proposed program is feasible, and, if it is, arrange for its evaluation.

The following procedures will be followed for feasible programs:

1. The student must submit to the associate dean of The Global School an educational program proposal, including a "definition of scope," and a concise statement of the educational goals of the proposed program. Goals (such as graduate school or employment) should be specified very clearly. The proposal must be detailed in terms of anticipated course and project work. The proposal must be submitted no later than one calendar year before the student's expected date of graduation, and normally before the student's third year.
2. The associate dean will name a three-member faculty committee, representing those disciplines most involved in the goals of the program, to evaluate the proposal. The committee may request clarification or additional information for its evaluation. The proposal, as finally accepted by the committee and the student, will serve as an informal contract to enable the student to pursue the stated educational goals most effectively.
3. Upon acceptance of the proposal, the student will notify the Office of Academic Advising and the Registrar's Office of the choice of ID (individually-designed) as the designation of major. The Department of Integrative and Global Studies in the Global School then becomes the student's academic department for purposes of record-keeping.
4. The three-person faculty committee will serve as the student's program advisory committee, and will devise and certify the distribution requirements (up to a limit of 10 units including the MQP) appropriate to the student's program.

Air Force Aerospace Studies

Lieutenant Adam Messer, DEPARTMENT HEAD

PROFESSOR: Lt A Messer

ASSISTANT PROFESSORS: Maj K. Blackman, Capt C. Rouleau

Mission

The mission of AFROTC is to develop leaders of character for tomorrow's Air Force and Space Force. The mission of the United States Air Force is to fly, fight and win...airpower anytime, anywhere. The United States

Space Force (USSF) is a military service that organizes, trains, and equips space forces in order to protect U.S. and allied interests in space and to provide space capabilities to the joint force. Successful graduates of the program receive a commission as a Second Lieutenant in the United States Air Force or Space Force.

Educational Objectives

Students who successfully complete the AFROTC program will develop:

1. An understanding of the fundamental concepts and principles of Air and Space.
2. A basic understanding of associated professional knowledge.
3. A strong sense of personal integrity, honor, and individual responsibility.
4. An appreciation of the requirements for national security.

Air Force ROTC Programs

There are two traditional routes to an Air Force commission through Air Force ROTC. Entering students may enroll in the Air Force Four-Year Program. Students with at least three academic years remaining in college may apply for the Accelerated Program.

Four- or Five-Year Program

The preferred program is the traditional Four-Year Program. To enroll, simply register for Air Force Aerospace Studies in the fall term of the freshman year in the same manner as other college courses. There is NO MILITARY OBLIGATION for the first two years of Air Force ROTC unless you have an Air Force ROTC scholarship.

The first two years are known as the General Military Course (GMC). Classes meet one hour per week and are required for freshmen and sophomores.

Individuals who successfully complete the GMC compete nationwide for entry into the Professional Officers Course (POC). POC classes meet three hours per week and are required for all juniors and seniors. Officer Candidates enrolled in the POC and on scholarship receive a nontaxable subsistence allowance of up to $500 each month.

Qualified Officer candidates will attend the Air Force ROTC field-training program for four weeks, usually between their sophomore and junior years.

Accelerated Program

For students who do not enroll in Air Force ROTC during their first year in college, it is possible to condense the two years of GMC membership into a single year, as long as the student has three more years of college left.

Other Aspects of the AFROTC Program

Leadership Laboratory:

Air Force ROTC officer candidates participate in a Leadership Laboratory (LLAB) where the leadership skills and management theories acquired in the classroom are put into practice. The LLAB meets once each week for approximately two hours.

This formal military training is largely planned and directed by the officer candidates. The freshmen and sophomores are involved in such initial leadership experiences as problem solving, dynamic leadership, team building, Air Force customs and courtesies, drill movements, Air Force educational benefits, Air Force career opportunities, and preparation for field training. The juniors and seniors are involved in more advanced leadership experiences as they become responsible for the planning and organizing of wing activities, including conducting the Leadership Laboratory itself.

Field Training:

The summer program is designed to develop military leadership, discipline, and evaluate performance. At the same time, the Air Force can evaluate each student's potential as an officer. Field training includes: expeditionary operations, Air Force professional development, marksmanship training, physical fitness, and survival training.

Base Visits:

Air Force ROTC officer candidates may have the opportunity to visit Air Force bases for firsthand observation of the operating Air Force.

Additional Information:

In addition to formal activities, the cadet wing plans and organizes a full schedule of social events throughout the academic year. These include a Dining-In, Military Ball, a Field Day, and intramural sports activities. Professional Development Training Programs, such as Advanced Cyber Education, internships with the National Reconnaissance Office, combative training, and global cultural language and immersion training may also be available to selected volunteer officer candidates during the summer. Students may also participate in Arnold Air Society, Drill Team, and Civil Air Patrol, among other activities.

Air Force Aerospace Studies

LT COL C. CUDE, DEPARTMENT HEAD

PROFESSOR: Lt Col C. Cude

ASSISTANT PROFESSORS: Maj K. Blackman, Capt C. Rouleau

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Military Science

LTC J Mazzocchi

PROFESSOR: LTC J Mazzoocchi

ASSISTANT PROFESSOR: MAJ J. R. Irwin

INSTRUCTORS: LTC (ret.) A. Elbthal, MSG A. Sutton, SFC E. Mejia

Mission Statement:

The Military Science and Leadership Program (Army ROTC) is a premiere leadership program offered by WPI. Open to all students within the Worcester Consortium, the program teaches valuable leadership skills and managerial traits that prepare students for careers in both the private and public sectors. Students partake in hands-on experiences that integrate traditional coursework with innovative training. Students develop strong decision-making and organizational management skills, while cultivating team-building and interpersonal skills, as well as mastering time and stress management techniques.

Objectives and Outcomes:

WPI's Army ROTC prepares multi-faceted future leaders. Students who participate in Army ROTC while pursuing their undergraduate and graduate studies are extremely marketable and highly sought after for their problem-solving and adaptable capabilities. As technology continues to transform organizations and corporations, ROTC students are at the forefront of these cutting-edge developments.

Program Descriptions:

The Military Science and Leadership program is intended to be a four-year program which encourages personal growth and cultivates overall character development.

A. The Basic Course:

The Basic Course serves as the foundation of the Army ROTC program and is taken over the first two years. The focal points of the Basic Course are leadership, teambuilding and communication skills. Students participate in adventure training (such as orienteering, rappelling and paintball) to put classroom teachings and core concept-strategies to practice.

Students may participate in the first two years of the program commitment free. Students awarded full-tuition scholarships or who participate in the Advanced Course (described below) incur a service obligation and may serve in the Army either full-time or part-time.

B. Advanced Course:

The Advanced Course is a more intensive leadership program that is taken during the Junior and Senior years, or, during two years of graduate studies. The curriculum continues its focus on problem solving and team building exercises while incorporating military tactics and Ethics.

Student interested in earning a commission as an Army Officer are required to enroll in the Advanced Camp (AC) at Ft Knox, Kentucky. AC is a six-week leadership and tactical course that students are paid to attend during the summer; it is the culmination of the students' training over their tenure on campus. If students decide later in their academic career that they would like to pursue Army ROTC, there are alternate entry options that allow them to receive Basic Course credit and to prepare them for Advanced Camp (1).

Students attending on an Army ROTC Scholarship receive a yearly book-allowance of $1,200 in addition to a monthly stipend. Both "scholarship" and "contracted, non-scholarship" students receive a monthly stipend of $420.00. Students interested in pursuing scholarships or enrolling in the Advanced Course must meet specific eligibility requirements.

Military Science

LTC Joseph T. Mazzocchi

PROFESSOR: LTC Joseph Mazzocchi

ASSISTANT PROFESSOR: MAJ Daniel Gimm, CPT Patrick Crews

INSTRUCTORS: MSG James Conley, MSG Charles Dougherty, SFC Donald Vota

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Pre-Health Programs

ADVISORS: E. Jacoby, A. Holmes

Students at WPI who wish to pursue careers in the health professions (e.g. medicine, dentistry, veterinary medicine, etc.) should, in consultation with their academic advisors, plan their academic programs to include courses in biology, general and organic chemistry, biochemistry, and physics including laboratory experiences. Although required courses for certain majors will naturally overlap with professional school prerequisites more than others, entry into medical or other health professions schools may be accomplished through any major program of study. It is important for students to work closely with their faculty advisors as well as the pre-health advisor to formulate an academic plan of study that will include the courses required for admission to health professions schools while still allowing for completion of all degree requirements. Individual admissions requirements will vary by school and program. Students should consult admissions websites of individual health professions programs for specific information about prerequisites. Pre-med students are encouraged to consult the Medical School Admissions Requirement (MSAR) resource.

WPI's project-focused curriculum offers a tremendous advantage to pre-health students. Health professions programs value teamwork, as well as cross-cultural, research, and community service experience, all of which can be demonstrated through project work. Because students will graduate from WPI with a degree in an academic discipline, they will have other career opportunities should they decide not to pursue a career in a health profession or should they choose to work for some time after graduation before continuing on to a health professions school. Students and alumni applying to health professions schools should plan to meet with the pre-health advisor to discuss the application process and arrange a letter of recommendation from the pre-health committee (if required) to support their application. Such meetings should ideally begin during a student's first year as an undergraduate student (or as soon as a student decides to pursue this path) and continue through their time at WPI.

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Pre-Law Programs

Advisor: K. Rissmiller

Law schools do not require that undergraduates complete any particular course of study. Thus, students who complete degrees in engineering and science (or other WPI programs of study) may wish to consider careers in law. Undergraduates interested in attending law school are encouraged to choose from among the many courses offered which explore legal topics. For those with greater interest, WPI offers a Minor in Law and Technology described on page 121. Courses with substantial legal content are listed among those courses fulfilling the requirements of the minor.

Enrolling in these courses will introduce students to the fundamentals of legal process and legal analysis. Students will study statutes, regulations and case law. These courses will, therefore, offer the student valuable exposure to the kind of material commonly studied in law schools and they may help demonstrate a student's interest to law school admission committees.

Many questions about law school can be answered online. The Law School Admissions Council (LSAC) offers the Law School Admission Test (LSAT) which is generally required for law school applications. Infomation about the test and other aspects of law school can be found on the LSAC website. Students interested in discussing career options and how they might prepare for law school are invited to contact Associate Dean Rissmiller in the Global School.

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Law schools do not require that undergraduates complete any particular course of study. Thus, students who complete degrees in engineering and science (or other WPI programs of study) may wish to consider careers in law. Undergraduates interested in attending law school are encouraged to choose from among the many courses offered which explore legal topics. For those with greater interest, WPI offers a Minor in Law and Technology described on page 121. Courses with substantial legal content are listed among those courses fulfilling the requirements of the minor.

Enrolling in these courses will introduce students to the fundamentals of legal process and legal analysis. Students will study statutes, regulations and case law. These courses will, therefore, offer the student valuable exposure to the kind of material commonly studied in law schools and they may help demonstrate a student's interest to law school admission committees.

Many questions about law school can be answered online. The Law School Admissions Council (LSAC) offers the Law School Admission Test (LSAT) which is generally required for law school applications. Infomation about the test and other aspects of law school can be found on the LSAC website. Students interested in discussing career options and how they might prepare for law school are invited to contact Associate Dean Rissmiller in the Global School.

Teacher Preparation Program

Advisor: Jillian DiBonaventura

Licensed teachers in STEM fields are in continual high demand across the United States. Participation and successful completion of our teacher preparation program will result in obtaining an Initial teaching licensure in the state of Massachusetts. WPI students may elect to pursue licensure in middle or high school mathematics, middle school general science, high school science (Biology, Chemistry, Physics), or technology/engineering while obtaining an undergraduate degree in the STEM-related major of their choice.

Specific content courses are required to meet Massachusetts requirements for Subject Matter Knowledge competency, but these are generally met by courses in a student's major. Joining this certificate program enables participants to pursue the content are of their choice while impacting the lives of middle and high school students in urban schools and the local community. Students wishing to discuss this option further are encouraged to contact Jillian DiBonaventura, Director of Teacher Preparation at the STEM Education Center.

Applications are accepted via eProjects twice yearly (B and C term), and more information can be found on our website or by contacting www.wpi.edu/+teach

https://www.wpi.edu/academics/undergraduate/teacher-preparation-program

Teacher Prep students must successfully complete the following requirements for initial licensure in the state of Massachusetts:

- Completion of an online portfolio that addresses the Candidate Assessment of Performance (CAP) required by the Department of Elementary and Secondary Education (DESE)
- Successful completion of a full-time teaching practicum in a local middle or high school (often completed as an IQP C/D term of junior year)
- Pass the state MTEL teaching tests in the following areas:
    - Communication and Literacy skills (Reading & Writing subtests)
    - Relevant Subject Matter test for the license sought
- Complete all program requirements (Pre-practicum fieldwork and workshops, Culturally Responsive Teaching trainings, Senior seminar and coursework)

Teacher Preparation Program
Advisor: Jillian DiBonaventura

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- Complete all program requirements (Pre-practicum fieldwork and workshops, Culturally Responsive Teaching trainings, Senior seminar and coursework)

Item #	Title	Units
PSY 2401	The Psychology of Education	1/3
	Choose one: PSY 2410, PSY 1401, or PSY 1404	
ID 3100	Teaching Methods in Mathematics and Science	1/3
ID 3200	Sheltered English Immersion Endorsement Course for Teachers	1/3

Course Descriptions

Bioinformatics and Computational Biology

BB 1003/BCB 1003 : Exploring Bioinformatics and Computational Biology

Life scientists are generating huge amounts of data on many different scales, from DNA and protein sequence, to information on biological systems such as protein interaction networks, brain circuitry, and ecosystems. Analyzing these kinds of data requires quantitative knowledge and approaches using computer science and mathematics. In this project-based course, students will use case studies to learn about both important biological problems and the computational tools and algorithms used to study them. Students will study a sampling of topics in the field; recent topics included complex disease genetics, HIV evolution, antibiotic resistance, and animal migration behavior. In addition, students will hear from several guest speakers about their interdisciplinary research. Computational tools explored will include both freely-available tools to analyze sequences and build phylogenetic trees (e.g. BLAST, MUSCLE, MEGA) as well as guided programming using languages such as Python, R, and Netlogo. Students may not receive credit for both BCB / BB 100X and BCB / BB 1003. BBT majors may count this course as fulfilling part of their quantitative science and engineering requirement, but not as part of their BB 1000 level course requirement.

Department

Biology and Biotechnology

Bioinformatics and Computational Biology

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

High school biology. Programming experience is not required.

BB 3010/BCB 3010 : Simulation in Biology

Computer simulations are becoming increasingly important in understanding and predicting the behavior of a wide variety of biological systems, ranging from metastasis of cancer cells, to spread of disease in an epidemic, to management of natural resources such as fisheries and forests. In this course, students will learn to use a graphical programming language to simulate biological systems. Most of the classroom time will be spent working individually or in groups, first learning the language, and then programming simulation projects. We will also discuss several papers on biological simulations from the primary scientific literature. In constructing and comparing their simulations, students will demonstrate for themselves how relatively simple behavioral rules followed by individual molecules, cells, or organisms can result in complex system behaviors. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Biology and Biotechnology

Bioinformatics and Computational Biology

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

Students taking this course must have a solid background in a biological area they would like to simulate, at about the depth provided by a BB 3000 level class. No programming experience is assumed.

BB 4801/BCB 4001 : Bioinformatics

In an age when the amount of new biological data generated each year is exploding, it has become essential to use bioinformatics tools to explore biological questions. This class will provide an understanding of how we organize, catalog, analyze, and compare biological data across whole genomes, covering a broad selection of important databases and techniques. Students will acquire a working knowledge of bioinformatics applications through hands-on use of software to ask and answer biological questions in such areas as genetic sequence and protein structure comparisons, phylogenetic tree analysis, and gene expression and biological pathway analysis. In addition, the course will provide students with an introduction to some of the theory underlying the software (for example, how alignments are made and scored). This course will be offered in 2022-23, and in alternating years thereafter.

Department

Biology and Biotechnology
Bioinformatics and Computational Biology

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

A working knowledge of concepts in genetics and molecular biology (BB2920 and BB2950 or equivalent), and statistics (MA 2610 or MA2611 or equivalent)

BCB 4002/CS 4802 : Biovisualization

This course will use interactive visualization to model and analyze biological information, structures, and processes. Topics will include the fundamental principles, concepts, and techniques of visualization (both scientific and information visualization) and how visualization can be used to study bioinformatics data at the genomic, cellular, molecular, organism, and population levels. Students will be expected to write small- to moderately-sized programs to experiment with different visual mappings and data types. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Bioinformatics and Computational Biology
Computer Science

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

CS 2102 or CS 2103, CS 2223, and one or more biology courses.

BCB 4003/CS 4803 : Biological and Biomedical Database Mining

This course will investigate computational techniques for discovering patterns in and across complex biological and biomedical sources including genomic and proteomic databases, clinical databases, digital libraries of scientific articles, and ontologies. Techniques covered will be drawn from several areas including sequence mining, statistical natural language processing and text mining, and data mining. This course will be offered in 2021-22, and in alternating years thereafter.

Department

Bioinformatics and Computational Biology
Computer Science

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

CS 2102 or CS 2103, CS 2223, MA 2610 or MA 2611, and one or more biology courses.

BCB 4004/MA 4603 : Statistical Methods in Genetics and Bioinformatics

This course provides students with knowledge and understanding of the applications of statistics in modern genetics and bioinformatics. The course generally covers population genetics, genetic epidemiology, and statistical models in bioinformatics. Specific topics include meiosis modeling, stochastic models for recombination, linkage and association studies (parametric vs. nonparametric models, family-based vs. population-based models) for mapping genes of qualitative and quantitative traits, gene expression data analysis, DNA and protein sequence analysis, and molecular evolution. Statistical approaches include log-likelihood ratio tests, score tests, generalized linear models, EM algorithm, Markov chain Monte Carlo, hidden Markov model, and classification and regression trees. This course will be offered in 2021-22, and in alternating years thereafter.

Department

Bioinformatics and Computational Biology
Mathematical Sciences

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

MA 2612, MA 2631 (or MA 2621), and BB 2920 or more biology courses.

Biology and Biotechnology

BB 1001 : Introduction to Biology

This course is designed for students seeking a broad overview of biologic concepts, especially at the cell and organism level. It is conducted in an active style including the use of case studies, class discussion/participation, and classroom polling systems. The major goal of this course is to help students become more informed citizens, skeptical when presented with data in the media, and knowledgeable enough to question and make informed decisions about scientific advances and science policy. It will primarily focus on current topics which may include stem cells, ethical uses of DNA, development of personalized medicine, genetic engineering, antibiotic resistance. This course is intended for non-life-science majors. This will not fulfill a major distribution requirement for BBT majors.

Department

Biology and Biotechnology

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

high school biology

BB 1002 : Environmental Biology

This course is designed for students seeking a broad overview of ecological systems and the effect of humans on the ecosystems. It provides an introduction to natural ecosystems, population growth, and the interaction between human populations and our environment. It is conducted in an active style including the use of case studies, class discussion/participation, and classroom polling systems. The major goal of this course is to help students become more informed environmental citizens, skeptical when presented with data in the media, and knowledgeable enough to question and make informed decisions about the environment. It will primarily focus on current topics but areas of discussion likely to be covered include ecosystems, populations, biodiversity, pollution, environmental economics and climate change. This course is intended for non- life-science majors. This will not fulfill a major distribution requirement for BBT majors.

Department

Biology and Biotechnology

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

high school biology

BB 1003/BCB 1003 : Exploring Bioinformatics and Computational Biology

Life scientists are generating huge amounts of data on many different scales, from DNA and protein sequence, to information on biological systems such as protein interaction networks, brain circuitry, and ecosystems. Analyzing these kinds of data requires quantitative knowledge and approaches using computer science and mathematics. In this project-based course, students will use case studies to learn about both important biological problems and the computational tools and algorithms used to study them. Students will study a sampling of topics in the field; recent topics included complex disease genetics, HIV evolution, antibiotic resistance, and animal migration behavior. In addition, students will hear from several guest speakers about their interdisciplinary research. Computational tools explored will include both freely-available tools to analyze sequences and build phylogenetic trees (e.g. BLAST, MUSCLE, MEGA) as well as guided programming using languages such as Python, R, and Netlogo. Students may not receive credit for both BCB / BB 100X and BCB / BB 1003. BBT majors may count this course as fulfilling part of their quantitative science and engineering requirement, but not as part of their BB 1000 level course requirement.

Department

Biology and Biotechnology

Bioinformatics and Computational Biology

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

High school biology. Programming experience is not required.

BB 1025 : Human Biology

This course presents students with an introduction to general concepts of human biology with particular focus on human structure and function. Concepts such as homeostasis, structure/function, and regulatory systems will be introduced. Discussion of current topics related to human health, such as personalized medicine and recent advances in cancer research and autoimmune disease will be integrated throughout the course. This course is intended for BBT and other life science majors.

Department

Biology and Biotechnology

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

a solid working knowledge of biological principles such as would be learned in a rigorous high school biology course.

BB 1035 : Biotechnology

Through lectures, discussion and project work, students will gain an understanding of the function of biological systems at the molecular and cellular level. This course will explore topics such as genes-to-proteins, cell cycle regulation, genomics, and cell signaling as foundational concepts in genetic and cellular engineering, synthetic biology, stem cell generation, regenerative and personalized medicine and the production of therapeutic biologics. Projects will be designed to facilitate students' understanding of the links between biological systems and biotechnology applications, including their impact on society. This course is intended for BBT and other life science majors.

Department

Biology and Biotechnology

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

a solid working knowledge of biological principles such as would be learned in a rigorous high school biology course.

BB 1045 : Biodiversity

Through lectures, readings, and discussions this course will examine the breadth, patterns, mechanisms, and conservation of biodiversity. Case studies and peer-to-peer learning will be used to examine threats to regional and global biodiversity and assess management and engineering strategies for solutions to the biodiversity crisis. Students will investigate and interpret past and contemporary research to quantify, document, and track trends in biodiversity. This course will use problem sets and assignments to explore the natural, social, and economic tradeoffs associated with threats to and conservation of biodiversity. Students will develop an area of expertise and synthesize their comprehension of topics through project work (e.g., management plan, report, presentation, citizen science). Finally, this course will provide a synthesis of the interdisciplinary nature of biodiversity conservation and how principles of conservation biology, landscape ecology, metapopulation biology, and biogeography can be applied to strategies aimed towards sustaining Earth's biota. This course is intended for BBT and other life science majors.

Department

Biology and Biotechnology

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

a solid working knowledge of biological principles such as would be learned in a rigorous high school biology course.

BB 2002 : Microbiology

Department

Biology and Biotechnology

Units 1/3

BB 2003 : Fundamentals of Microbiology

This course will introduce the basic principles of microbiology through lectures, discussion, readings, and projects. The course will explore both the fundamental biology of microbes and the ways in which microbes influence society and the world. Topics will include the morphology, physiology, and genetics of unicellular organisms with a primary focus on bacteria. Special attention will be given to organisms known to have important roles in health, research, industry, and the environment. This course is designed for all biology majors and other students who seek a good general education in modern biology.

Department

Biology and Biotechnology

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

A basic understanding of cell biology and elementary biochemical processes (BB 1035, BB 2550 or equivalent).

BB 2030 : Plant Diversity

This course focuses on general biological concepts as they relate to the vast array of plant species and their taxonomic links. Current uses of major plant phyla in both society and the biotechnology industry will be explored. Some emphasis will be given to economically important species chosen from agronomic and non-agronomic situations. Students may not receive credit for both BB 2030 and BB 1040.

Department

Biology and Biotechnology

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

a working knowledge of concepts in biodiversity (BB 1045 or equivalent)

BB 2040 : Principles of Ecology

This course is intended to help students understand ecological concepts at different levels of integration, from individuals to ecosystems, and the linkages among them. Students will also practice the application of qualitative and quantitative models to ecological systems and processes, as well as hypothesis generation, experimental design, and analysis and interpretation of data. In a format that includes team-based case studies, discussion and presentations, and ecological simulations, students will explore topics in both basic and applied ecology, which may include population ecology, host-parasite ecology and epidemiology, climate change, and sustainable agriculture, among others.

Department

Biology and Biotechnology

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

a working knowledge of concepts in biodiversity (BB 1045 or equivalent) and integral and differential calculus

BB 2050 : Animal Behavior

This course will provide an introduction to the scientific study of animal behavior. A combination of lecture, reading, and video will be used to illustrate how proximate and ultimate forces interact to shape animal behavior in complex and fascinating ways. Behavioral phenomena in all members of the animal kingdom will be discussed and analyzed from ecological, evolutionary, cognitive, and neurobiological perspectives to highlight how the use of an integrative approach has greatly accelerated our ability to solve complex behavioral problems. Primary scientific literature will be used to outline experimental tools and techniques used to investigate behavior in different contexts, including communication, foraging, navigation, mate choice, predation, and social behavior.

Department

Biology and Biotechnology

Category

Category I (offered at least 1x per Year)

Units 1/3

BB 2550 : Cell Biology

The goal of this course is to help students to develop a working understanding of the unifying concepts that define cell structure and function including replication, metabolism, regulation, communication and death. Applications in therapeutics, molecular medicine, and genetic engineering will be introduced. Classic and current research examples will provide practice in hypothesis generation and testing as well as making clear the importance of a working knowledge of cell biology to support advances in biotechnology and medicine. The course serves as the foundation of all fields of modern biology, and is recommended for all BBT and other life science majors.

Department

Biology and Biotechnology

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

a working knowledge of concepts in biotechnology (BB 1035 or equivalent)

BB 2902 : Enzymes, Proteins, and Purification

This course gives basic practical experimental experience in enzymology, how enzymes work and how to purify them for later use. These techniques are the foundation the design and production of many therapeutic products. Examples of the types of techniques and experiences included in this course are: • The action and optima of enzyme catalysis • Induction of enzyme production • Quantification and detection techniques for proteins • Extraction and purification of protein from biological material using column chromatography • Identification of compounds using Thin Layer Chromatography

Department

Biology and Biotechnology

Category

Category I (offered at least 1x per Year)

Units 1/6

Recommended Background

a working knowledge of concepts in biotechnology (BB 1035 or equivalent).

BB 2903 : Anatomy and Physiology

This course is an active exploration of a number of topics in anatomy and physiology through the use of simulations, measurement and hands on discovery. It will be particularly relevant to any student considering a health related career, doing work where body structure is relevant or has interest in how body systems connect. A significant portion of this discovery will be accomplished by a hands-on dissection. Examples of the specific types of techniques and experiences included in this course are: • Comparative and general anatomy of several organisms • Physiology and function of body systems, processes and organs. • Enzyme Linked Immunosorbent Assay (ELISA) • Microscopy

Department

Biology and Biotechnology

Category

Category I (offered at least 1x per Year)

Units 1/6

Recommended Background

a working knowledge of concepts in human biology (BB 1025 or equivalent).

BB 2904 : Ecology, Environment, and Animal Behavior

This course examines topics in ecology and animal behavior through hands on experimentation and simulation. Activities in this course include interactions and observation of live animals as well as some outdoor activities and environmental sampling. This course will be relevant to students who have an interest in biology at more than the individual organism level as well as those with majors involving environmental and ecological concerns. Examples of the specific types of techniques and experience included in this course are: • Observing, recording, understanding, and analyzing animal behaviors • Handling of organisms • Environmental and ecological assessment and sampling • Observations of population dynamics

Department

Biology and Biotechnology

Category

Category I (offered at least 1x per Year)

Units 1/6

Recommended Background

a working knowledge of concepts in biodiversity (BB 1045 or equivalent).

BB 2915 : Searching for Solutions in Soil: Microbial and Molecular Investigations

Students in this course will be part of a national student crowd sourcing initiative, developed in response to a decreasing supply of effective antibiotics and increased microbial resistance, to identify novel antibiotics produced by soil bacteria. Operating in an authentic research paradigm, students will gain skill in the process of scientific inquiry, including hypothesis generation and testing, and in common procedures of microbial culture and characterization. They will learn about and have the opportunity to use the techniques of recombinant DNA including the use of plasmids, restriction enzymes, and PCR. At the conclusion of the course students will report their findings in a poster style format and will be able to see the results of other groups around the country. Students may not receive credit for this course and either BB 2901 and BB 2905.

Department

Biology and Biotechnology

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

A familiarity with current topics in biotechnology or microbiology such as those introduced in BB 1035 and BB 2003, or equivalent.

BB 2917 : Hunting for Phage

Students in this course will become part of a national crowd sourcing initiative to isolate and identify novel bacteriophage. Students will design experiments to initially isolate phage (bacterial viruses) from environmental samples they have collected, then characterize and determine their DNA sequence. The DNA sequences will be used in the follow-on bioinformatics course BB 3526 Phage Hunters: The Analysis. Students in this course will make significant contributions to the field of genomics while gaining skill in the process of scientific inquiry, including hypothesis generation and testing, and practice in common microbiologic techniques. Students enrolled in this course may wish to consider enrollment in BB 3526 (Phage Hunters: The Analysis). Students that have already received course credit for BB 29IX or BB 2916 may not also receive credit for BB 2917.

Department

Biology and Biotechnology

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

A working knowledge of biotechnology or microbiology (BB 1035 or BB 2003, or equivalent).

BB 2920 : Genetics

Through interactive lectures, group problem solving, and analysis of primary scientific literature, this course will help students understand the gene concept and its application in modern biological analysis. This course will cover patterns of inheritance, the relationship between genotype and phenotype, and the transmission, coding, and expression of genetic information contained in DNA, in several model systems. Students will gain an understanding of the modern tools of genetic analysis, including gene cloning, creation of transgenic organisms, high-throughput sequencing and RNA interference. Applications of genetic analysis to current advancements in agriculture through crop improvements, and in human health, including gene therapy and personalized medicine, will be explored.

Department

Biology and Biotechnology

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

a working knowledge of concepts in biotechnology (BB 1035 or equivalent)

BB 2950 : Molecular Biology

Through a combination of lectures and in class discussion, students will learn and understand the essential concept of molecular biology, including the mechanisms by which information stored in nucleic acids is maintained and processed in living systems. An evolutionary framework will help illustrate how genomes are structured and how they change. Basic regulatory mechanisms of gene expression will be addressed, with emphasis in eukaryotic gene regulatory proteins. The concepts learned in this course will provide the foundation to continue exploring this rapidly expanding field.

Department

Biology and Biotechnology

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

a working knowledge of concepts in biotechnology (BB 1035 or equivalent)

BB 3003 : Medical Microbiology: Plagues of the Modern World, a Case Study Approach

Using a case study approach, this course will focus on molecular mechanisms of pathogenesis of a wide range of infectious diseases and host-pathogen interactions including a survey of human immunobiology. Students will gain an understanding of microbes that are of medical relevance including bacteria, viruses, fungi, and protozoans, enabling them to make informed decisions about appropriate medical interventions. Students will be able to evaluate how their day-to-day choices impact public health as well as alter microbial communities. This interactive course is designed for all biology and biochemistry majors as well as other students with the recommended background who have an interest in the pathogenesis of disease. Students may not receive credit for both BB 2002 Microbiology: Plagues of the Modern World and BB 3003.

Department

Biology and Biotechnology

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

a working knowledge of concepts in biotechnology, molecular biology and microbiology (BB 1035, BB 2950, and BB 2003 or equivalent)

BB 3010/BCB 3010 : Simulation in Biology

Computer simulations are becoming increasingly important in understanding and predicting the behavior of a wide variety of biological systems, ranging from metastasis of cancer cells, to spread of disease in an epidemic, to management of natural resources such as fisheries and forests. In this course, students will learn to use a graphical programming language to simulate biological systems. Most of the classroom time will be spent working individually or in groups, first learning the language, and then programming simulation projects. We will also discuss several papers on biological simulations from the primary scientific literature. In constructing and comparing their simulations, students will demonstrate for themselves how relatively simple behavioral rules followed by individual molecules, cells, or organisms can result in complex system behaviors. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Biology and Biotechnology

Bioinformatics and Computational Biology

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

Students taking this course must have a solid background in a biological area they would like to simulate, at about the depth provided by a BB 3000 level class. No programming experience is assumed.

BB 3050 : Cancer Biology

In this course, students will learn and apply advanced cellular and molecular biology concepts to understand causes and consequences of cancer cell transformation. Through an integration of primary literature and lecture material students will explore how research into basic mechanisms of cancer biology is used to identify therapeutic targets, and inform drug design. This course will cover discussion of the hallmarks of cancer including the deregulation of cell growth, cell death, and metabolism; corruption of genome stability, evasion of immune response, and metastatic potential.

Department

Biology and Biotechnology

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

A thorough understanding of genetics (BB 2920 or equivalent), molecular biology (BB 2950 or equivalent), and cell biology (BB 2550 or equivalent).

BB 3080 : Neurobiology

The nervous system underlies every aspect of our behavior, including sensation, movement, emotion, and cognition. In this course, students will develop an understanding of neurobiology at several levels, from the physiology of individual neurons, through the functioning of neural circuits, and finally to the behavior of neural systems such as vision, motion, and memory. The class will be based on lectures accompanied by in-class activities, and will include weekly discussion of a paper from the scientific literature. The class will focus each year on a guiding theme, such as a particular neurotransmitter system, and will emphasize research on human neurological problems, such as schizophrenia, addiction, Alzheimer's disease, and autism. Students may not receive credit for both BB 4080 and BB 3080.

Department

Biology and Biotechnology

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

a working knowledge of concepts in cell biology (BB 2550 or equivalent), and either genetics or molecular biology (BB2920 or BB2950 or equivalent)

Suggested

a working knowledge of concepts related to the anatomy and physiology of movement and communication (BB 3101 or equivalent).

BB 3101 : Human Anatomy & Physiology: Movement and Communication

The form and function of the systems that are responsible for the support, movement, internal communication, and interaction of the human body with its environment will be presented and discussed: Integumentary, Skeletal, Muscular, Nervous (including the senses), and Endocrine. Students who have received credit for BB 2130 may not take BB 3101 for credit.

Department

Biology and Biotechnology

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

BB 1025 and BB 2550.

Suggested

Concurrent Laboratory Module: BB 3511.

BB 3102 : Human Anatomy & Physiology: Transport and Maintenance

The form and function of the systems of the human body that provide for the intake, distribution, and processing of nutrients, water, and oxygen, and the systems that safeguard health by elimination of wastes, regulation of metabolism, and surveillance against disease will be presented and discussed. Digestive, Respiratory, Circulatory, Lymphatic, Endocrine, Urinary, and Reproductive. Students who have received credit for BB 3110 may not take BB 3102 for credit.

Department

Biology and Biotechnology

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

BB 1025 and BB 2550; CH 1010 and CH 1020.

Suggested

Concurrent Laboratory Module: BB 3514.

BB 3120 : Plant Physiology

This course explores the remarkable physiology of plants and emphasizes their importance in past and future life on earth. Conserved and unique aspects of plant cellular physiology will provide the foundation to understand the challenges of life on land and multicellularity. Topics such as water relations, mineral nutrition, intra- and inter-cellular transport, photosynthesis, and light responses will be discussed. Examples from the recent literature will be used to illustrate some of the key existing problems in plant physiology. This course will be offered in 2021-22, and in alternating years thereafter. Some sections of this course may be offered as Writing Intensive (WI).

Department

Biology and Biotechnology

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

a working knowledge of concepts in biodiversity and cell biology (BB 1045 and BB 2550 or equivalent) and in chemical reactions (CH 1020 or equivalent)

BB 3140 : Evolution: Pattern and Process

In this course, students will explore the foundations of micro- and macro-evolutionary theory and will learn to apply these fundamental evolutionary principles through critical analysis of the primary scientific literature. In a course format that emphasizes team-based case studies, discussion of recent and classic papers, and computer simulation of evolutionary processes, students will explore the evolutionary foundations of a wide range of biological disciplines, and will gain experience in critical evaluation of approaches, arguments, and points of view in the field. Topics may include the history of life on Earth; biogeography and the origins of biodiversity; host-pathogen coevolution; and genomic and molecular evolution, among others. This course will be offered in 2021-22, and in alternating years thereafter.

Department

Biology and Biotechnology

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

a working knowledge of the principles of ecology and genetics (BB2040 and BB2920 or equivalent) and integral and differential calculus

BB 3512 : Molecular Genetics Lab

The topic of gene therapy will be used to give students experience with several fundamental skills in biotechnological research and practice: on-line information search and retrieval, computer cloning, and biological sequence analysis and manipulation. Course is entirely computer based.

Department

Biology and Biotechnology

Category

Category I (offered at least 1x per Year)

Units 1/6

Recommended Background

a working knowledge of laboratory skills and concepts in molecular biology, microbiology and genetics (BB 2901, BB 2950, BB 2002, and BB 2920 or equivalent).

BB 3513 : Cell Culture Techniques for Animal Cells

Basic laboratory skills in mammalian cell culture to include cell counting, freezing and thawing cell lines, culture of suspension and attached cells.

Department

Biology and Biotechnology

Category

Category I (offered at least 1x per Year)

Units 1/6

Recommended Background

BB 2901, BB 2550 and knowledge of aseptic techniques. Concurrent or prior registration in BB 4008 is recommended.

BB 3515 : Physiologic Systems Laboratory

Exercises in this course focus on computer and wet laboratory studies of nervous, musculoskeletal, circulatory and respiratory system structure, function, and physiology. Students will gain experience in hypothesis generation and testing and will be introduced to an interactive biomedical/physiological data acquisition and analysis system.

Department

Biology and Biotechnology

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

A working knowledge of laboratory skills and concepts in anatomy and physiology (BB 2903, BB 3101 and BB 3102 or equivalent).

Students may not receive credit for both BB 3515 and BB 3511 or BB 3515 and BB 3514.

BB 3517 : Fermentation

The experiments in this course focus on basic fermentation theory and practice, common to any bio-product production facility. Students will gain significant experience in hypothesis generation and testing as they work toward the goal of optimizing their proposed culture media.

Department

Biology and Biotechnology

Category

Category I (offered at least 1x per Year)

Units 1/6

Recommended Background

a working knowledge of laboratory techniques in molecular biology, and microbiology (BB 2901 or equivalent), and concepts in cell biology (BB 2550 or equivalent).

BB 3519 : Protein Purification

This is a laboratory course focusing on the theory and practice of protein purification from a primary source. Chromatographic techniques will include two more of the most commonly used in the biotech industry.

Department

Biology and Biotechnology

Category

Category I (offered at least 1x per Year)

Units 1/6

Recommended Background

a working knowledge of laboratory skills in enzyme and protein purification, and concepts in biochemistry (BB 2902 and CH 4110 or equivalent).

BB 3521 : Microscopy

Through a research-based laboratory and short lectures, students will learn the basic principles of image formation, resolution, and digital imaging. Students will develop confidence in the use of the light microscope and be able to apply different modes of microscopy to solve biological problems. This course emphasizes a quantitative approach to microscopy and digital imaging applied toward simple phenotypic analysis. Student will develop scientific writing skills and learn how to prepare professional quality images. Some sections of this course may be offered as Writing Intensive (WI).

Department

Biology and Biotechnology

Category

Category II (offered at least every other Year)

Units 1/6

Recommended Background

a working knowledge of laboratory techniques in molecular biology, and microbiology (BB 2901 or equivalent), and concepts in cell biology (BB 2550 or equivalent)

BB 3525 : Plant Physiology

Basic studies in the biochemical and physical systems plants use to sustain life; includes an introduction to plant cell culture techniques. Concurrent or prior registration in BB 3120 is recommended. Students who have received credit for BB 325X may not receive credit for BB 3525. Some sections of this course may be offered as Writing Intensive (WI).

Department

Biology and Biotechnology

Category

Category I (offered at least 1x per Year)

Units 1/6

Recommended Background

BB 1045 and BB 2903.

BB 3526 : Phage Hunters: the Analysis

In this computer lab students will work with phage genomic sequences obtained from novel bacteriophages isolated in BB 2910, Phage Hunters: The Quest. The raw genome files will be finished and oriented; students will then search the sequence to identify and map existing genes and other genomic components (sequence annotation). Additional course goals are to do an initial comparative genomic analysis and post-annotation experimentation. The ultimate goal is to produce novel bacteriophage genome sequences that are ready to be submitted to GenBank, the US repository of DNA sequence information at the National Institute of Health. Students planning to take this course may wish to consider enrollment in BB 2916 (Phage Hunters: The Quest) Students may not receive credit for both BB 350X and BB 3526

Department

Biology and Biotechnology

Category

Category I (offered at least 1x per Year)

Units 1/6

Recommended Background

a working knowledge of genome structure and function (BB 2920, BB 2950, or equivalent).

BB 3527 : Molecular Biology and Genetic Engineering: Approaches and Applications

In this laboratory based course, students will learn to use current techniques in molecular and genetic engineering to address authentic research questions. Students will design and execute experiments to assess hypotheses, and evaluate data relative to those hypotheses. Specific approaches may include the generation of novel plasmids, genes, and cells, designed to specifically address contemporary problems in biology and biomedical science. In each offering, the problem addressed will be selected from and the results contribute to current faculty research initiatives. Students may not receive credit for both BB 356X and BB 3527.

Department

Biology and Biotechnology

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Working knowledge of the principles of molecular biology (BB 2950 or BB 2920 or equivalent) and cell biology (BB 2550 or equivalent), as well as relevant biology laboratory experience (BB 2905, BB 2915, or BB 2916).

BB 3530 : Immunotherapies: The Next Generation of Pharmaceuticals

While the production of monoclonal antibodies has been around since the 1970s, their clinical use as human therapeutics represents an increasingly popular and promising application. Beginning with a hybridoma cell line and using a discovery based approach, students in this course will explore the processes involved in the production and purification of monoclonal antibodies. Using cells in culture to produce the antibody, students will explore the efficacy and cost of a purification scheme involving separation techniques such as ion exchange and affinity chromatography to produce a purified product. Purification will be assessed using typical analytical techniques such as spectroscopy, electrophoresis and immunological based methods.

Department

Biology and Biotechnology

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

A working knowledge of laboratory skills in enzyme and protein purification (BB 2902 or equivalent) and concepts in cell biology and biochemistry (BB 2550 and CH 4110 or equivalent). Some knowledge of immunology may be beneficial.

BB 3570 : Cell Culture Models for Tissue Regeneration

This course is an intensive hands-on laboratory that explores mammalian cells as building blocks of complex tissues *in vitro*. In addition to learning standard cell culture skills, students will have the opportunity to examine cell survival, proliferation, differentiation, and function under different culture conditions. The course culminates with design and development of a cell-based system for an application in regenerative medicine (e.g., wound healing and fibrosis). Students will synthesize and present their work in the form of a research manuscript.

Department

Biology and Biotechnology

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

A working knowledge of the principles of cell biology (BB 2550 or equivalent) and molecular biology and/or genetics (BB 2920 or 2950 or equivalent) as well as foundational lab experience such as that offered in the BB 2900 lab sequence.

BB 3620 : Developmental Biology

Through lecture, reading, and discussion, this course will help students understand how developmental biologists study the development of a fertilized egg into a multi-cellular animal. Beginning with the description of developmental events, the major problems of developmental biology such as determination of cell fate, differentiation, and pattern formation will be explored. Emphasis will be placed on techniques such as analysis of mutations, molecular genetics, gene transfer, and the use of model organisms. Societal implications of the ability to control the outcome of development will be discussed. This course will be offered in 2021-22, and in alternating years thereafter.

Department

Biology and Biotechnology

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

a working knowledge of concepts in microbiology, cell biology and genetics (BB 2002, BB 2550, and BB 2920 or equivalent)

BB 3920 : Immunology

Through lecture, reading, and discussion, this course will help students understand the origin of immune cells in bone marrow development, the distinction between innate and adaptive immunity, and the function of the immune system in health and disease. The mechanisms responsible for the exquisite specificity of the adaptive immune system will be described. Throughout the course, the probable paths of evolution of the immune system will be stressed. As examples of major genetic diseases of immunity, case studies will be discussed on a weekly basis.

Department

Biology and Biotechnology

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

a working knowledge of the concepts in cell biology, genetics and biochemistry (BB 2550, BB 2920, CH 4110 and 4120 or equivalent)

BB 4150 : Environmental Change: Problems and Approaches

Department

Biology and Biotechnology

Units 1/3

BB 4170/CH 4170 : Experimental Genetic Engineering

This laboratory course focuses on modern DNA technologies and general applications of gene manipulation. Topics include gene amplification and recombination, promoter and plasmid engineering, gene expression and analysis, model systems, CRISPR, genomics and transgenics. Experiments in this course are integrated into an overall genetic engineering project throughout the term that will involve techniques such as electrophoresis, quantitative spectro-fluorimetry, and real-time quantitative PCR. Methods of data analysis, common statistical approaches and technical writing will be emphasized throughout the course.

Department

Biology and Biotechnology

Chemistry and Biochemistry

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Knowledge of organic chemistry fundamentals as well as biochemical concepts including DNA replication and recombination, RNA synthesis and protein synthesis. Familiarity with cellular architecture is also recommended. See CH 2310, BB 2550, BB 4010 and CH 4110 or equivalent.

BB 4190/CH 4190 : Regulation of Gene Expression

Through lectures, problem sets, reading and discussion, and presentations this course will help elucidate for students the processes that allow regulated gene expression, mechanisms used in each type of regulation, and methods and techniques used for investigation of regulatory mechanisms. Readings from the current original research literature will explore the growing use of model systems and "omics" level approaches to enhance our ever expanding understanding of the gene regulatory mechanisms. The development of cell-based therapeutics and genetic engineering as they relate to gene regulation will be introduced.

Department

Chemistry and Biochemistry
Biology and Biotechnology

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

A working knowledge of concepts in biochemistry and molecular genetics (CH 4110, 4120, 4130 and BB 4010 or equivalent)

BB 4260 : Synthetic Biology

Do we yet have the technology to engineer life? Can we control gene expression to create organisms that function in useful ways? Do we understand the tenets of genetic regulation as well as we think we do? These important questions and more are investigated by the emerging field of Synthetic Biology. In this course, students will explore this exciting new realm of biology through in-depth analysis and discussion of primary literature. Topics to be covered include the design and construction of synthetic gene circuits, synthesis of new genes and genomes, logic gate regulation of gene expression, and the latest applications of synthetic biology to advances in medicine, information processing, and the environment. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Biology and Biotechnology

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

Students should have a strong foundational knowledge of cell biology, molecular biology, and genetics, as would be obtained from BB2550, BB2920, and BB2950.

BB 4801/BCB 4001 : Bioinformatics

In an age when the amount of new biological data generated each year is exploding, it has become essential to use bioinformatics tools to explore biological questions. This class will provide an understanding of how we organize, catalog, analyze, and compare biological data across whole genomes, covering a broad selection of important databases and techniques. Students will acquire a working knowledge of bioinformatics applications through hands-on use of software to ask and answer biological questions in such areas as genetic sequence and protein structure comparisons, phylogenetic tree analysis, and gene expression and biological pathway analysis. In addition, the course will provide students with an introduction to some of the theory underlying the software (for example, how alignments are made and scored). This course will be offered in 2022-23, and in alternating years thereafter.

Department

Biology and Biotechnology
Bioinformatics and Computational Biology

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

A working knowledge of concepts in genetics and molecular biology (BB2920 and BB2950 or equivalent), and statistics (MA 2610 or MA2611 or equivalent)

BB 4900 : Capstone Experience in Biology and Biotechnology

These classes will serve as integrative experiences for students majoring in Biology & Biotechnology. The course will help students integrate concepts from other courses in the curriculum, practice skills of critical analysis, and evaluate and communicate scientific information effectively. The specific theme of each offering will center around a current topic of biological interest, and may include such areas as genomics, cancer, environmental problems, and synthetic biology. Prior to enrolling in the seminar, a student should have completed all of the BB course distribution requirements for BBT majors at the 1000 and 2000 level, or should seek advice from the course instructor. Topics will be announced prior to registration in the year preceding the course offering.

Department

Biology and Biotechnology

Category

Category I (offered at least 1x per Year)

Units 1/3

ISU BB : Special Topics

Experimental courses, special conferences and seminars are offered by advance arrangement only. The lab activities in these courses will provide foundational skills needed for the study of living organisms and systems at the molecular, organismal and environmental level. In these labs students will begin building the skills to carry into more advanced labs, their MQPs and professional careers. In particular students will gain experience with scientific procedures and techniques, technical equipment, teamwork, laboratory safety, hypothesis generation and testing, scientific data analysis (including statistics), oral and written scientific communication and skills common to all areas of biology.

Department

Biology and Biotechnology

Category

Category I (offered at least 1x per Year)

Units 1/3

Chemistry and Biochemistry

BB 4170/CH 4170 : Experimental Genetic Engineering

This laboratory course focuses on modern DNA technologies and general applications of gene manipulation. Topics include gene amplification and recombination, promoter and plasmid engineering, gene expression and analysis, model systems, CRISPR, genomics and transgenics. Experiments in this course are integrated into an overall genetic engineering project throughout the term that will involve techniques such as electrophoresis, quantitative spectro-fluorimetry, and real-time quantitative PCR. Methods of data analysis, common statistical approaches and technical writing will be emphasized throughout the course.

Department

Biology and Biotechnology

Chemistry and Biochemistry

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Knowledge of organic chemistry fundamentals as well as biochemical concepts including DNA replication and recombination, RNA synthesis and protein synthesis. Familiarity with cellular architecture is also recommended. See CH 2310, BB 2550, BB 4010 and CH 4110 or equivalent.

BB 4190/CH 4190 : Regulation of Gene Expression

Through lectures, problem sets, reading and discussion, and presentations this course will help elucidate for students the processes that allow regulated gene expression, mechanisms used in each type of regulation, and methods and techniques used for investigation of regulatory mechanisms. Readings from the current original research literature will explore the growing use of model systems and "omics" level approaches to enhance our ever expanding understanding of the gene regulatory mechanisms. The development of cell-based therapeutics and genetic engineering as they relate to gene regulation will be introduced.

Department

Chemistry and Biochemistry
Biology and Biotechnology

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

A working knowledge of concepts in biochemistry and molecular genetics (CH 4110, 4120, 4130 and BB 4010 or equivalent)

CH 516 : Chemical Spectroscopy

Advanced topics in identification of organic species and determination of molecular structure by spectroscopic methods. Methods covered include !H- and 13 C-NMR, mass spectrometry and infrared and UV-visible spectroscopy. This course is concerned only with interpretation of spectra and does not cover techniques obtaining them; there is no laboratory.

Department

Chemistry and Biochemistry

Units 0/1

CH 536 : Theory and Applications of NMR Spectroscopy

This course emphasizes the fundamental aspects of ID and 2D nuclear magnetic resonance spectroscopy (NMR). The theory of pulsed Fourier transform NMR is presented through the use of vector diagrams. A conceptual nonmathematical approach is employed in discussion of NMR theory. The course is geared toward an audience which seeks an understanding of NMR theory and an appreciation of the practical applications of NMR in chemical analysis. Students are exposed to hands-on NMR operation. Detailed instructions are provided and each student is expected to carry out his or her own NMR experiments on a Bruker AVANCE 400 MHz NMR spectrometer.

Department

Chemistry and Biochemistry

Units 1/3

CH 538 : Medicinal Chemistry

This course will focus on the medicinal chemistry aspects of drug discovery from an industrial pharmaceutical Research and Development perspective. Topics will include Chemotherapeutic Agents (such as antibacterial, antiviral and antitumor agents) and Pharmacodynamic Agents (such as antihypertensive, antiallergic, antiulcer and CNS agents).

For details about this Graduate Course, Click Here.

Department

Chemistry and Biochemistry

Units 1/3

Recommended Background

CH 2310, CH 2320, and CH 2330.

CH 1010 : Chemical Properties, Bonding, and Forces

The CH 1010 course is an introduction to chemistry using the fundamental structures of atoms as a starting point. Emphasis is placed on discussing how all properties of matter as well as bonding mechanisms arise from atomic structure. Lewis structures and molecular orbitals are used to understand bonding, and the intermolecular forces present in chemicals systems are used as a prelude to reactivity patterns covered in future courses.

Department

Chemistry and Biochemistry

Category

Category I (offered at least 1x per Year)

Units 1/3

CH 1020 : Chemical Reactions

Bonding theories introduced earlier in the sequence are applied to chemical reactions, including reduction/oxidation reactions, to demonstrate patterns in reactivity. Solution thermodynamics, concentration scales, and colligative properties are discussed in the context of balanced chemical reactions both in aqueous solution and in the gas phase.

Department

Chemistry and Biochemistry

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Properties of matter, basic bonding theory, Lewis structures and molecular orbitals, intermolecular forces. See CH 1010.

CH 1030 : Kinetics, Equilibrium and Thermodynamics

This course will examine the dynamic nature of solutions at the molecular level, and will develop an understanding of the mathematical aspects of molecular dynamics and equilibrium. Reaction kinetics will be outlined in detail leading into exploration of various fundamentals and examples of equilibrium processes in the gas phase as well as in solution, including acid-base chemistry and precipitation. Principles of thermodynamics will be introduced (entropy, free energy), and relationships with equilibrium will be explored. Case studies in current topics will be emphasized throughout the course.

Department

Chemistry and Biochemistry

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Properties of matter, basic bonding theory, Lewis structures and molecular orbitals, intermolecular forces. Redox reactions, solution thermodynamics, colligative properties, balancing of chemical reactions. See CH 1010 and CH 1020.

CH 1040 : Spectroscopy in Organic and Polymer Chemistry

We will examine the nature of molecular motions and their interaction with electromagnetic radiation, which provides us with all of our structural information about molecules. In addition, students will be introduced to the fundamentals of mass spectrometry and electrochemistry. The concepts of these techniques will be discussed in the context of structural organic chemistry and polymer characterization

Department

Chemistry and Biochemistry

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Properties of matter, basic bonding theory, Lewis structures and molecular orbitals, intermolecular forces. Redox reactions, solution thermodynamics, colligative properties, balancing of chemical reactions. Reaction kinetics, equilibrium processes, acid-base chemistry and principles of thermodynamics (entropy, free energy). See CH 1010, CH 1020 and CH 1030.

CH 2310 : Organic Chemistry I

A systematic survey of the major reaction types and functional groups in organic chemistry. The course will provide a representative collection of characteristic reactions and transformations of a variety of types of organic molecules. Most of the examples will be drawn from aliphatic chemistry. Some theoretical models will be introduced with a view toward establishing a general overview of the material. The course is intended for chemists, chemical engineers, pre-medical students and all those interested in the biosciences. A familiarity with the material presented in the general chemistry courses is assumed.

Department

Chemistry and Biochemistry

Category

Category I (offered at least 1x per Year)

Units 1/3

CH 2320 : Organic Chemistry II

Modern theories of aromaticity, including a general assessment of delocalized bonding. The chemistry of some significant functional groups not surveyed in Organic Chemistry I, and the meaning of acidity and basicity in organic chemistry, will be more fully explored. The course will provide an introduction to the systematic synthesis of polyfunctional organic compounds.

Department

Chemistry and Biochemistry

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

CH 2310. The course is intended for chemists, chemical engineers and bio-science majors.

CH 2330 : Organic Chemistry III

This course fully explores three most important analytical methods in organic chemistry: infrared spectroscopy, mass spectrometry, and nuclear magnetic resonance spectroscopy. It will continue the coverage of aromatic chemistry. New topics to be introduced include structures, properties, and reactivities of aldehydes and ketones, carboxylic acids and their derivatives, amines, and the interaction among polyfunctional compounds. It reinforces the retrosynthetic analysis and multistep synthesis of organic compounds and revisits reaction mechanisms and stereochemistry of all the new functional groups studied.

Department

Chemistry and Biochemistry

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

CH 2310 and CH 2320. The course is intended for biochemists, chemists, chemical engineers and bioscience majors.

CH 2360 : Organic Laboratory

Laboratory experience in standard methods for the preparation and purification of organic compounds. The course will provide sufficient training in laboratory technique so that no previous laboratory experience beyond that of general chemistry is required. This course may be taken concurrently or following lecture courses in organic chemistry. Recommended for pre-medical students and students majoring in disciplines outside of chemistry and biochemistry that desire laboratory experience in basic methods of organic synthesis.

Department

Chemistry and Biochemistry

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Fundamentals of chemistry, basic chemistry laboratory techniques (e.g., basic synthesis, spectral analysis and chemical separation skills).

CH 2640 : Experimental Chemistry I: Instrumental Analysis

This laboratory course focuses on the application of modern instrumental methods of analysis to chemical, biochemical and environmental problems. Practical experience is gained in quantitative electrochemistry, ultraviolet-visible spectrophotometry, fluorometry and bioluminescence, high performance liquid chromatography, and capillary electrophoresis. Principles of experimental design and execution are developed as student teams select a chemical, biochemical or environmental problem, formulate an approach, conduct the analysis, and present findings to the class. Methods of data analysis and common statistical approaches are emphasized throughout the course.

Department

Chemistry and Biochemistry

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

CH 1010, CH 1020, CH 1030, CH 1040.

CH 2650 : Modern Physical Chemistry Methods

This laboratory course emphasizes principles, techniques, and instrumentation employed in modern physical chemistry with a view towards applications throughout the molecular sciences. Investigations include chemical thermodynamics and phase equilibria; gas-phase, solution-phase, and interfacial reaction kinetics and dynamics; and molecular modeling of small molecules. Emphasis includes data collection, interpretation, error analysis, and write-up.

Department

Chemistry and Biochemistry

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Fundamentals in chemistry (see CH 1010 — CH 1040), knowledge in thermodynamics (see CH 3510).

CH 2660 : Organic Synthesis and Analysis Laboratory

The emphasis in CH 2660 is on fundamental techniques essential for the synthesis, purification, and characterization of organic compounds. These techniques include setting up, running and monitoring reactions, isolation and purification by solvent extraction, crystallization, distillation, and chromatographic techniques, followed by determination of physical properties and characterization by infrared (IR) and nuclear magnetic resonance (NMR) spectroscopy Micro-synthetic methods and multi-step synthesis are introduced. This course differs from CH 2360 by providing in-depth experience with spectroscopic characterization of molecular structure and hands-on training operating core instruments in addition to methods of organic synthesis. This course is required for students majoring in chemistry, and is recommended for students majoring in biochemistry and disciplines outside of chemistry that desire a strong background in methods of organic synthesis and characterization.

Department

Chemistry and Biochemistry

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Fundamentals of chemistry (see CH 1010, CH 1020, CH 1030) and chemical characterization techniques (see CH 1040), basic chemistry laboratory techniques (e.g., basic chemical synthesis, spectral analysis and chemical separation skills).

CH 2670 : Investigation of Coordination Complexes Through Inquiry

The synthesis, isolation, and characterization of inorganic compounds are emphasized. Syntheses of main group compounds, classical transition metal complexes, and organotransition metal compounds are included. In addition to reinforcing and building on standard techniques of synthesis and characterization, several new techniques are introduced: synthesis under inert atmosphere, measurement of magnetic susceptibility by NMR, and cyclic voltammetry. Some exposure to 13C NMR is also provided. The final experiment of the course requires the student to design a synthesis for a compound selected from a list provided, based on strategies learned in the course.

Department

Chemistry and Biochemistry

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Principles of inorganic chemistry, chemical bonding and reactions, thermodynamic stability of inorganic species, solubility and precipitation of inorganic compounds. Advanced chemistry laboratory skills (see CH 2660)

CH 3310 : Advanced Organic Chemistry

This course will review and further develop concepts introduced in CH 2310, CH 2320, and CH 2330. These concepts will include oxidation states of organic compounds, acidity and basicity, and stereochemistry and conformational analysis. Chemical reactivity will be emphasized and will include functional group interconversion and ionic and free radical carbon-carbon bond formation. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Chemistry and Biochemistry

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

CH 2310, CH 2320, and CH 2330. This course is intended for students planning to take advanced courses in organic and/or medicinal chemistry and for chemists, biochemists, chemical engineers, and bio-science majors who desire a stronger background in organic chemistry.

CH 3410 : Structure, Bonding, and Reactivity in Inorganic Chemistry

This course provides the fundamental understanding of atomic, molecular and solid state structures and properties. Orbital structures of atoms, symmetry of molecules and point groups are used to understand chemical bonding and reactions. Various acid-base concepts are explored to analyze the acidity of cations and basicity of anions, solubility and precipitations of inorganic compounds, and metal-ligand binding affinities. Redox properties are discussed using Pourbaix diagrams. Thermodynamic stabilities of inorganic species are discussed using acid-base and redox concepts and thermochemical analyses are used to analyze chemical reactivity at atomic, molecular, and solid state level.

Department

Chemistry and Biochemistry

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Firm understanding of general chemistry topics (CH 1010-CH 1030)

CH 3510 : Chemical Thermodynamics

The content of this course will be the development of the principles of classical thermodynamics. The laws of thermodynamics will be developed by using a series of increasingly complex model systems and a universal equation of state is formulated which incorporates the relationships illustrated by these model systems. Using this equation it will be possible to appreciate that thermodynamic laws are applicable to all systems of matter, regardless of their complexity. Finally, the principles developed are applied to problems of a chemical nature, focusing on predicting the spontaneity of chemical reactions. The material in this course will be of greatest interest to those students enrolled in the basic sciences including biology, chemistry, and physics, and in applied fields such as chemical engineering, materials science and biotechnology.

Department
Chemistry and Biochemistry
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
Students should be familiar with the material covered in the general chemistry sequence CH 1010-1040, and calculus including multi variables.

CH 3530 : Quantum Chemistry

An introduction to quantum mechanics with applications to atomic and molecular species. The course will be developed systematically beginning with the postulates of quantum mechanics. The Schroedinger equation will be applied to systems such as the particle in a box, the rigid rotor, the harmonic oscillator and the hydrogen atom. Emphasis will be given to a quantum mechanical description of multielectron atoms, molecular bonding and spectroscopy. This course is normally for students in their third year.

Department
Chemistry and Biochemistry
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
a solid foundation in elementary physics and calculus.

CH 3550 : Chemical Dynamics

This course deals in a general way with the interactions between energy and molecules, and considers how energetic and structural considerations affect the outcome of molecular interactions. The manipulation of kinetic data and results is stressed. Selected topics from both organic and inorganic chemistry are analyzed in terms of reaction thermodynamics, rates and mechanisms. Students are expected to be familiar with thermodynamics, equilibria, reaction rates and the Periodic Table of the elements.

Department
Chemistry and Biochemistry
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
As background for this sequence, CH 1010, CH 1020, CH 1030, CH 1040, CH 2310, CH 2320, and CH 2330, or their equivalents, are recommended.

CH 4110 : Protein Structure and Function

The fundamental concepts of protein architecture and dynamics are presented with an emphasis on the functional outcomes of chemistry coordinated in three dimensional space. Catalytic mechanics and enzyme function are outlined in detail. Current methods in the determination of enzyme structure and function will be discussed, and students will use common tools in macromolecular analysis and structural modeling. Case studies in enzyme dysfunction, disease, and current research will be used throughout the course.

The following three courses, CH 4110, CH 4120, and CH 4130, are a three-term sequence intended to provide a strong emphasis in biochemistry.

Department

Chemistry and Biochemistry

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Familiarity with organic chemistry topics including functional groups, nucleophilic addition and substitution reactions, stereochemistry, and carbonyl chemistry. General knowledge of cellular architecture is also recommended. See CH 2310, CH 2320, CH 2330, and BB 2550 or equivalent.

CH 4120 : Lipids and Biomembrane Functions

Oriented around biological membranes, this course begins with a description of lipids and proteins forming biomembranes. Permeability and the mechanism of transmembrane mass transport are presented. Transport of electrons and redox equivalents is explained within the context of aerobic production of ATP and plant photosynthesis. Finally the transport of information across biomembranes in signal transduction and neurotransmission are discussed.

The following three courses, CH 4110, CH 4120, and CH 4130, are a three-term sequence intended to provide a strong emphasis in biochemistry.

Department

Chemistry and Biochemistry

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Knowledge of organic chemistry fundamentals as well as concepts including protein structure and folding, catalytic mechanics, enzyme kinetics, and ATP synthesis and hydrolysis mechanisms. See CH 2310, BB 2550, and CH 4110 or equivalent.

CH 4130 : Nucleic Acids and Bioinformation

This course presents the structure and function of DNA. Precursors and biomolecules that give rise to DNA, the mechanism of DNA replication, RNA synthesis, and protein synthesis are described in detail. In addition to mechanistic studies, regulation of these processes is covered as well as those of genetic mutation, DNA repair, and epigenetics.

The following three courses, CH 4110, CH 4120, and CH 4130, are a three-term sequence intended to provide a strong emphasis in biochemistry.

Department

Chemistry and Biochemistry

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Knowledge of organic chemistry fundamentals as well as concepts including protein structure and folding, catalytic mechanics, enzyme kinetics, and ATP synthesis and hydrolysis mechanisms. See CH 2310, CH 2320, CH 2330, BB 2550, and CH 4110 or equivalent.

CH 4140 : Metabolism and Disease

This course presents a thorough analysis of the most relevant metabolic processes in cells. The catabolism of sugars and lipids will be presented in the context of energy generation and storage. Nucleotide and amino acid metabolism will discussed as building blocks for large biomolecules. Throughout the course the links between metabolism, hereditary pathologies, as well as risk of metabolic imbalances such as diabetes and obesity will be presented.

Department

Chemistry and Biochemistry

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Familiarity with organic chemistry topics including functional groups, nucleophilic addition and substitution reactions, stereochemistry, and carbonyl chemistry. General knowledge of cellular architecture is also recommended. See CH 2310, CH 2320, CH 2330, and BB 2330 or equivalent. Specific concepts that we will discuss are: Glucose and glycogen metabolism; Gluconeogenesis; Citric Acid Cycle; Lipid, amino acid and nucleotide metabolisms; Mammalian Fuel Metabolism: Integration and Regulation.

CH 4150 : Enzymology and Protein Characterization Laboratory

The experiments in this laboratory course have been designed to acquaint the students with the basic skills necessary to perform biochemical studies. The course will cover, for instance, protein purification, subcellular fractionation, enzyme kinetics (Km, Vmax, specific activity, effector-protein interaction, etc.), exclusion and ion exchange chromatography, and electrophoresis.

Department

Chemistry and Biochemistry

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Knowledge of organic chemistry fundamentals as well as concepts including protein structure and folding, catalytic mechanics, enzyme kinetics, and ATP synthesis and hydrolysis mechanisms. See CH 2310, BB 2550, and CH 4110 or equivalent.

CH 4160 : Membrane Biophysics

This course will focus on different areas of biophysics with special emphasis on membrane phenomena. The biomedical-biological importance of biophysical phenomena will be stressed. The course will begin with the introduction of the molecular forces relevant in biological media and subsequently develop the following topics: Membrane Structure and Function; Channels, Carriers and Pumps; Nerve Excitation and related topics; and Molecular Biophysics of Motility. This course will be offered in 2021-22, and in alternating years thereafter.

Department

Chemistry and Biochemistry

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

prior knowledge of Biochemistry (CH 4110, CH 4120), Mechanics (PH 1110) and Electricity (PH 1120).

CH 4330 : Organic Synthesis

Modern synthetic methods as applied to the construction of societally relevant target molecules will be the focus of this course. Discussions may emphasize the logic and strategy in synthetic approaches toward active pharmaceutical ingredients, agrochemicals, fine chemicals, materials, and other targets of interest. The analysis of current examples from the primary literature will draw attention to the most state-of-the-art synthetic tactics. Recommended for graduate students and undergraduates who have a basic understanding of the principles governing organic reactions, such as those covered in CH2310, CH2320, and CH2330. This course will be offered in 2022-23 and alternate years thereafter.

Department

Chemistry and Biochemistry

Category

Category II (offered at least every other Year)

Units 1/3

CH 4420 : Principles and Applications of Group Theory in Chemistry

The principles and applications of group theory as a tool in chemistry are presented with an emphasis on systems in inorganic chemistry. Topics covered include the development of symmetry group representations and character tables, applications of group theory in quantum-mechanical wavefunctions, molecular vibrations, ligand field theory, and molecular orbital theory. Particular emphasis will be placed on transition metal complexes, including classical coordination complexes, metal carbonyl complexes, and organotransition metal complexes.

Department

Chemistry and Biochemistry

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

CH 1010 - CH 1040, CH 2640 - CH 2670, CH 3410, CH 3530, and CH 3550, and a fundamental understanding of atomic, molecular and solid state structures and properties. Thermodynamic stabilities of inorganic species. Acidity, solubility and precipitation of inorganic compounds (see CH 3410).

CH 4520 : Chemical Statistical Mechanics

This course deals with how the electronic, translational, rotational and vibrational energy levels of individual molecules, or of macromolecular systems, are statistically related to the energy, entropy, and free energy of macroscopic systems, taking into account the quantum mechanical properties of the component particles. Ensembles, partition functions, and Boltzmann, Fermi-Dirac, and Bose-Einstein statistics are used. A wealth of physical chemical phenomena, including material related to solids, liquids, gases, spectroscopy and chemical reactions are made understandable by the concepts learned in this course. This course will be offered in 2021-22, and in alternating years thereafter.

Department

Chemistry and Biochemistry

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

CH 3510 and CH 3530, or equivalent, and mathematics through differential and integral calculus.

CHE 554/CH 554 : Molecular Modeling

This course trains students in the area of molecular modeling using a variety of quantum mechanical and force field methods. The approach will be toward practical applications, for researchers who want to answer specific questions about molecular geometry, transition states, reaction paths and photoexcited states. No experience in programming is necessary; however, a background at the introductory level in quantum mechanics is highly desirable. Methods to be explored include density functional theory, ab initio methods, semiempirical molecular orbital theory, and visualization software for the graphical display of molecules.

Department

Chemical Engineering

Chemistry and Biochemistry

Units 1/3

Data Science

CS 4433/DS 4433 : Big Data Management and Analytics

This course introduces the emerging techniques and infrastructures for big data management and analytics including parallel and distributed database systems, map-reduce, Spark, and NoSQL infrastructures, data stream processing systems, scalable analytics and mining, and cloud-based computing. Query processing and optimization, access methods, and storage layouts developed on these infrastructures will be covered. Students are expected to engage in hands-on projects using one or more of these technologies.

Department

Computer Science

Data Science

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Knowledge in database systems at the level of CS4432, and programming experience are assumed.

CS 4804 : Data Visualization

This course trains students in data visualization, the graphical communication of data and information for presentation, confirmation, and exploration. Students learn the stages of the visualization pipeline, including data characterization, mapping data attributes to graphical attributes, user task abstraction, visual display techniques, tools, paradigms, and perceptual issues. Students evaluate the effectiveness of visualizations for specific data, task, and user types. Students implement visualization algorithms and undertake projects involving the use of commercial and public-domain visualization tools.

Department

Data Science

Computer Science

Units 1/3

Recommended Background

CS 2102 or CS 2103, and CS 2223.

DS 1010 : Data Science I: Introduction to Data Science

This course provides an introduction to the core concepts in Data Science. It covers a broad range of methodologies for working with and making informed decisions based on real-world data. Core topics introduced in this course include basic statistics, data exploration, data cleaning, data visualization, business intelligence, and data analysis. Students will utilize various techniques and tools to explore, understand and visualize real-world data sets from various domains and learn how to communicate data results to decision makers.

Department

Data Science

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

None

DS 2010 : Data Science II: Modeling and Data Analysis

This course focuses on model- and data-driven approaches in Data Science. It covers methods from applied statistics (regression), optimization, and machine learning to analyze and make predictions and inferences from real-world data sets. Topics introduced in this course include basic statistics (regression), analytics (explanatory and predictive), basics of machine learning (classification and clustering), eigen values and singular matrices, data exploration, data cleaning, data visualization, and business intelligence. Students will utilize various techniques and tools to explore and understand real-world data sets from various domains.

Department

Data Science

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Data science basics equivalent to DS 1010, applied statistics and regression equivalent to MA2611 and MA 2612, and the ability to write computer programs in a scientific language equivalent to a CS programming course at the CS 1000 or CS 2000 level are assumed.

DS 3010 : Data Science III: Computational Data Intelligence

This course introduces core methods in Data Science. It covers a broad range of methodologies for working with large and/or high-dimensional data sets to making informed decisions based on real-world data. Core topics introduced in this course include data collection through use cycle, data management of large-scale data, cloud computing, machine learning and deep learning. Students will acquire experience with big data problems through hands-on projects using real-world data sets.

Department

Data Science

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Data science basics equivalent to DS 1010, and data analysis principles and modeling equivalent to DS 2010, knowledge of basic statistics equivalent to (MA 2611 and MA 2612), and the ability to program equivalent to (CS 1004 or CS 1101 or CS 1102) and (CS 2102, CS 2103 or CS 2119), as well as understanding of databases equivalent to (CS 3431 or MIS 3720) are assumed.

DS 4635/MA 4635 : Data Analytics and Statistical Learning

The focus of this class will be on statistical learning - the intersection of applied statistics and modeling techniques used to analyze and to make predictions and inferences from complex real-world data. Topics covered include: regression; classification/clustering; sampling methods (bootstrap and cross validation); and decision tree learning. Students may not receive credit for both MA 463X and MA 4635.

Department

Data Science

Mathematical Sciences

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Linear Algebra (MA 2071 or equivalent), Applied Statistics and Regression (MA 2612 or equivalent), Probability (MA 2631 or equivalent). The ability to write computer programs in a scientific language is assumed.

Computer Science

BCB 4002/CS 4802 : Biovisualization

This course will use interactive visualization to model and analyze biological information, structures, and processes. Topics will include the fundamental principles, concepts, and techniques of visualization (both scientific and information visualization) and how visualization can be used to study bioinformatics data at the genomic, cellular, molecular, organism, and population levels. Students will be expected to write small- to moderately-sized programs to experiment with different visual mappings and data types. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Bioinformatics and Computational Biology
Computer Science

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

CS 2102 or CS 2103, CS 2223, and one or more biology courses.

BCB 4003/CS 4803 : Biological and Biomedical Database Mining

This course will investigate computational techniques for discovering patterns in and across complex biological and biomedical sources including genomic and proteomic databases, clinical databases, digital libraries of scientific articles, and ontologies. Techniques covered will be drawn from several areas including sequence mining, statistical natural language processing and text mining, and data mining. This course will be offered in 2021-22, and in alternating years thereafter.

Department

Bioinformatics and Computational Biology
Computer Science

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

CS 2102 or CS 2103, CS 2223, MA 2610 or MA 2611, and one or more biology courses.

CS 1004 : Introduction to Programming for Non-Majors

This course introduces students to the fundamental principles of programming in imperative and scripting languages. Topics include control structures, iterators, functional decomposition, and basic data structures (such as records). Students will be expected to implement, test, and debug programs. Through the use of compelling applications and lab exercises, students will learn how to interface with external data systems and control devices.

Department

Computer Science

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

none. All Computer Science students and other students wishing to prepare for 3000-level courses in Computer Science should take CS 1101/1102 instead of CS 1004. This course provides sufficient background for CS 2301 Systems Programming for Non-Majors.

CS 1101 : Introduction to Program Design

This course introduces principles of computation and programming with an emphasis on program design. Topics include the design, implementation, and testing of programs that use a variety of data structures (such as structures, lists, and trees), functions, conditionals, recursion, and higher-order functions. Students will be expected to design simple data models, and implement and debug programs in a functional programming language.

Department

Computer Science

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

none. Either CS 1101 or CS 1102 provides sufficient background for further courses in the CS department. Undergraduate credit may not be earned for both this course and CS 1102.

CS 1102 : Accelerated Introduction to Program Design

In the first half of the term, this course covers the same functional programming material as CS 1101 at roughly twice the pace. The second half of the term is a preview of selected advanced Computer Science topics, such as the design and implementation of application-specific languages, macros, programming with the HTTP protocol, and continuation-passing style. Students will be expected to complete an open-ended individual programming project.

Department

Computer Science

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Substantial prior programming experience (including functions, recursion, and lists, as would be covered in high-school Advanced Placement Computer Science A courses, but not necessarily AP CS Principles courses). Either CS 1101 or CS 1102 provides sufficient background for further courses in the CS department. Undergraduate credit may not be earned for both this course and CS 1101.

CS 2011 : Introduction to Machine Organization and Assembly Language

This course introduces students to the structure and behavior of modern digital computers and the way they execute programs. Machine organization topics include the von Neumann model of execution, functional organization of computer hardware, the memory hierarchy, caching performance, and pipelining. Assembly language topics include representations of numbers in computers, basic instruction sets, addressing modes, stacks and procedures, low-level I/O, and the functions of compilers, assemblers, linkers, and loaders. The course also presents how code and data structures of higher-level languages are mapped into the assembly language and machine representations of a modern processor. Programming projects will be carried out in the C language and the assembly language of a modern processor.

Department

Computer Science

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

CS 2301 or CS 2303, or a significant knowledge of C/C++.

CS 2022/MA 2201 : Discrete Mathematics

This course serves as an introduction to some of the more important concepts, techniques, and structures of discrete mathematics providing a bridge between computer science and mathematics. Topics include sets, functions and relations, propositional and predicate calculus, mathematical induction, properties of integers, counting techniques, and graph theory. Students will be expected to develop simple proofs for problems drawn primarily from computer science and applied mathematics.

Department

Computer Science
Mathematical Sciences

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

None.

CS 2102 : Object-Oriented Design Concepts

This course introduces students to an object-oriented model of programming. Building from the design methodology covered in CS 1101/CS 1102, this course shows how programs can be decomposed into classes and objects. By emphasizing design, this course shows how to implement small defect-free programs and evaluate design decisions to select an optimal design under specific assumptions. Topics include inheritance, exceptions, interface, design by contract, basic design patterns, and reuse. Students will be expected to design, implement, and debug object-oriented programs composed of multiple classes and over a variety of data structures.

Department

Computer Science

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

CS 1101 or CS 1102.

CS 2103 : Accelerated Object-Oriented Design Concepts

This course covers the data structures and general program-design material from CS2102, but assumes that students have significant prior experience in object-oriented programming. The course covers object-oriented design principles and data structures more deeply and at a faster pace than in CS 2102. Students will be expected to design, implement, test, debug, and critique programs both for correctness and adherence to good object-oriented design principles. The course is designed to strengthen both the design skills and algorithmic thinking of students who already have a foundation in object-oriented programming. Advanced Placement Computer Science A courses should provide sufficient background; students from AP CS Principles courses or gentler introductions to Java Programming are advised to take CS2102 instead. Students may receive credit for only one of the following three courses: CS 2102, CS 2103, CS 210X.

Department

Computer Science

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

CS 1101 or CS 1102 and significant prior experience writing object-oriented programs from scratch.

CS 2119 : Application Building with Object-Oriented Concepts

This course introduces students to an object-oriented model of programming, with an emphasis on the programming approaches useful in creating software applications. Students will be expected to design, implement, and debug object-oriented programs. Topics include inheritance, user interfaces, and database access. This course is for non-CS majors with prior programming experience and an interest in building software applications.

Department

Computer Science

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Some programming experience such as found in CS 1101, CS 1102, or CS 1004.

CS 2223 : Algorithms

Building on a fundamental knowledge of data structures, data abstraction techniques, and mathematical tools, a number of examples of algorithm design and analysis — worst case and average case — will be developed. Topics include greedy algorithms, divide-and-conquer, dynamic programming, heuristics, and probabilistic algorithms. Problems will be drawn from areas such as sorting, graph theory, and string processing. The influence of the computational model on algorithm design will be discussed. Students will be expected to perform analysis on a variety of algorithms.

Department

Computer Science

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

CS 2102 or CS 2103, and CS 2022.

CS 2301 : Systems Programming for Non-Majors

This course introduces the C programming language and system programming concepts to non-CS majors who need to program computers in their own fields. The course assumes that students have had previous programming experience. It quickly introduces the major concepts of the C language and covers manual memory management, pointers and basic data structures, the machine stack, and input/output mechanisms. Students will be expected to design, implement, and debug programs in C. All Computer Science students and other students wishing to prepare for upper-level courses in Computer Science should take CS 2303 instead of CS 2301. Students who have credit for CS 2303 may not receive subsequent credit for CS 2301.

Department

Computer Science

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

CS 1101, CS 1102, or CS 1004 or previous experience programming a computer.

CS 2303 : Systems Programming Concepts

This course introduces students to a model of programming where the programming language exposes details of how the hardware stores and executes software. Building from the design concepts covered in CS 2102, this course covers manual memory management, pointers, the machine stack, and input/ output mechanisms. The course will involve large-scale programming exercises and will be designed to help students confront issues of safe programming with system-level constructs. The course will cover several tools that assist programmers in these tasks. Students will be expected to design, implement, and debug programs in C++ and C. The course presents the material from CS 2301 at a fast pace and also includes C++ and other advanced topics.

Department

Computer Science

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

CS 2102, CS 2103, or CS 2119 and/or substantial object-oriented programming experience.

CS 3013 : Operating Systems

This course provides the student with an understanding of the basic components of a general-purpose operating system. Topics include processes, process management, synchronization, input/output devices and their programming, interrupts, memory management, resource allocation, and an introduction to file systems. Students will be expected to design and implement a large piece of system software in the C programming language. Undergraduate credit may not be earned both for this course and for CS 502.

Department

Computer Science

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

CS 2303 or CS 2301, and CS 2011.

CS 3041 : Human-Computer Interaction

This course develops in the student an understanding of the nature and importance of problems concerning the efficiency and effectiveness of human interaction with computer-based systems. Topics include the design and evaluation of interactive computer systems, basic psychological considerations of interaction, interactive language design, interactive hardware design, and special input/output techniques. Students will be expected to complete several projects. A project might be a software evaluation, interface development, or an experiment.

Department

Computer Science

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

CS 2102, CS 2103, or CS 2119.

CS 3043 : Social Implications of Information Processing

This course makes the student aware of the social, moral, ethical, and philosophical impact of computers and computer-based systems on society, both now and in the future. Topics include major computer based applications and their impact, human machine relationships, and the major problems of controlling the use of computers. This course is recommended for juniors and seniors.

Department

Computer Science

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

a general knowledge of computers and computer systems.

CS 3133 : Foundations of Computer Science

This course introduces the theoretical foundations of computer science. These form the basis for a more complete understanding of, and proficiency in computer science. Topics include computational models, formal languages, and an introduction to computability and complexity theory, including NP-completeness. Students will be expected to complete a variety of exercises and proofs. Undergraduate credit may not be earned for both this course and for CS 5003. Students who have credit for CS 4123 may not receive credit for CS 3133.

Department

Computer Science

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Discrete Mathematics (CS 2022 or equivalent), and Algorithms (CS 2223 or equivalent).

CS 3431 : Database Systems I

This course introduces the student to the design, use, and application of database management systems. Topics include the relational data model, relational query languages, design theory, and conceptual data design and modeling for relational database design. Techniques that provide for data independence and minimal redundancy will be discussed. Students will be expected to design and implement database system applications. Undergraduate credit may not be earned both for this course and for CS 4431 or CS 542.

Department

Computer Science

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

CS 2022 and either CS 2102, CS 2103, or CS 2119.

CS 3516 : Computer Networks

This course provides a broad view of computer networks. The course exposes students to all seven layers of OSI Reference Model while providing an introduction into newer topics such as wireless networking and Internet traffic concerns. The objective is to focus on an understanding of fundamental concepts of modern computer network architecture from a design and performance perspective. Topics covered include physical layer considerations, network protocols, wide area networks, local area networks, wireless networks, switches and routing, congestion, Internet traffic, and network security. Students will be expected to do extensive systems/network programming and will be expected to make use of simulation and measurement tools to gain an appreciation of current network design and performance issues. This course is also highly recommended for RBE and IMGD majors.

Department

Computer Science

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

CS 2301 or CS 2303, or a significant knowledge of C/C++.

CS 3733 : Software Engineering

This course introduces the fundamental principles of software engineering. Modern software development techniques and life cycles are emphasized. Topics include requirements analysis and specification, analysis and design, architecture, implementation, testing and quality, configuration management, and project management. Students will be expected to complete a project that employs techniques from the topics studied. This course should be taken before any course requiring a large programming project. Undergraduate credit may not be earned both for this course and for CS 509.

Department

Computer Science

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

CS 2102, CS 2103, or CS 2119.

CS 4032/MA 3257 : Numerical Methods for Linear and Nonlinear Systems

This course provides an introduction to modern computational methods for linear and nonlinear equations and systems and their applications. Topics covered include solution of nonlinear scalar equations, direct and iterative algorithms for the solution of systems of linear equations, solution of nonlinear systems, and the eigenvalue problem for matrices. Error analysis will be emphasized throughout.

Department

Computer Science

Mathematical Sciences

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

MA 2071. An ability to write computer programs in a scientific language is assumed.

CS 4033/MA 3457 : Numerical Methods for Calculus and Differential Equations

This course provides an introduction to modern computational methods for differential and integral calculus and differential equations. Topics covered include interpolation and polynomial approximation, approximation theory, numerical differentiation and integration, and numerical solutions of ordinary differential equations. Error analysis will be emphasized throughout.

Department
Computer Science
Mathematical Sciences

Category
Category I (offered at least 1x per Year)

Units 1/3

Recommended Background
MA 2051. An ability to write computer programs in a scientific language is assumed. Undergraduate credit may not be earned for both this course and for MA 3255/CS 4031.

CS 4099 : Special Topics in Computer Science

Instances of this course will explore advanced and emerging topics that are not covered by the current regular CS offerings. Content and format will vary to suit the interests and needs of the faculty and students. This course may be repeated for credit as topics change.

Department
Computer Science

Category
Category III (offered at discretion of dept/prgm)

Units 1/3

CS 4100/IMGD 4100 : Artificial Intelligence for Interactive Media and Games

Algorithms and programming techniques from artificial intelligence (AI) are key contributors to the experience of modern computer games and interactive media, either by directly controlling a non-player character (NPC) or through more subtle manipulation of the environment. This course will focus on the practical AI programming techniques currently used in computer games for NPC navigation and decision-making, along with the design issues that arise when AI is applied in computer games, such as believability and real-time performance. The course will also briefly discuss future directions in applying AI to games and media. Students will be expected to complete significant software development projects using the studied techniques. This course will be offered in 2021-22, and in alternating years thereafter.

Department
Computer Science
Interactive Media and Game Development

Category
Category II (offered at least every other Year)

Units 1/3

Recommended Background
Object-oriented design concepts (CS 2102 or CS 2103), algorithms (CS 2223), and knowledge of technical game development (IMGD 3000 or IMGD 4000).

CS 4120 : Analysis of Algorithms

This course develops the skill of analyzing the behavior of algorithms. Topics include the analysis — with respect to average and worst case behavior — and correctness of algorithms for internal sorting, pattern matching on strings, graph algorithms, and methods such as recursion elimination, dynamic programming, and program profiling. Students will be expected to write and analyze programs. Undergraduate credit may not be earned both for this course and for CS 5084. This course will be offered in 2022-23, and in alternating years thereafter.

Department
Computer Science

Category
Category II (offered at least every other Year)

Units 1/3

Recommended Background
Algorithms (CS 2223 or equivalent), and some knowledge of probability.

CS 4123 : Theory of Computation

Building on the preliminaries established in CS 3133, this course explores fundamental questions of computability and complexity. Emphasis is on both mathematical foundations and applications to computing practice. Topics include the Church-Turing thesis, the halting problem, NP-completeness, time and space complexity classes, and related material as determined by the instructor. Students will be expected to read and write mathematical proofs.

Department

Computer Science

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

CS 3133.

CS 4233 : Object-Oriented Analysis and Design

This Software Engineering course will focus on the process of Object-Oriented Analysis and Design. Students will be expected to complete a large number of exercises in Domain Modeling, Use Case Analysis, and Object-Oriented Design. In addition, the course will investigate Design Patterns, which are elements of reusable object-oriented software designs. This course will survey a set of design patterns and consider how these patterns are described and used to solve design problems. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Computer Science

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

CS 2303 and CS 3733.

CS 4241 : Webware: Computational Technology for Network Information Systems

This course explores the computational aspects of network information systems as embodied by the World Wide Web (WWW). Topics include languages for document design, programming languages for executable content, scripting languages, design of WWW based human/computer interfaces, client/server network architecture models, high level network protocols (e.g., http), WWW network resource discovery and network security issues. Students in this course will be expected to complete a substantial software project (e.g., Java based user interface, HTML/CGI based information system, WWW search mechanisms).

Department

Computer Science

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

CS 2102, CS 2103, or CS 2119; and CS 3013.

CS 4300/IMGD 4300 : Graphics, Simulation, and Aesthetics

This course trains students to create accelerated simulations using Graphics Processing Unit (GPU) programming techniques, and to render the output of these simulations in aesthetically interesting ways. The aesthetic focus of the course is grounded by examining the histories of experimental animation, video synthesis, and the use of simulation in the digital arts. Students will evaluate the effectiveness of GPU-accelerated techniques for a variety of simulations and will create their own aesthetic explorations of appropriate simulations throughout the course.

Department

Computer Science

Interactive Media and Game Development

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

Students should have experience with graphics, web, or game engine programming and multimedia development. One of CS 4731 (Computer Graphics), CS 4241 (Webware), or IMGD 4000 (Technical Game Development II) should provide sufficient background for this course.

CS 4341 : Introduction to Artificial Intelligence

This course studies the problem of making computers act in ways which we call "intelligent". Topics include major theories, tools and applications of artificial intelligence; aspects of knowledge representation; searching and planning; and natural language understanding. Students will be expected to complete projects which express problems that require search in state spaces and to propose appropriate methods for solving the problems. Undergraduate credit may not be earned both for this course and for CS 534.

Department

Computer Science

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

CS 2102 or CS 2103; CS 2223; and CS 3133.

CS 4342 : Machine Learning

In this course, students will explore both theoretical and practical aspects of machine learning, including algorithms for regression, classification, dimensionality reduction, clustering, and density estimation. Specific topics may include neural networks and deep learning, Bayesian networks and probabilistic graphical models, principal component analysis, k-means clustering, decision trees and random forests, support vector machines, and kernel methods.

Department

Computer Science

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Multivariate Calculus (MA 1024 or MA 1034), Linear Algebra (such as MA 2071), Probability (MA 2621 or MA 2631), and Algorithms (CS 2223). Students may not earn credit for both CS 453X and CS 4342. Undergraduate credit may not be earned both for this course and for CS 539.

CS 4401 : Software Security Engineering

This course provides an introduction to the pitfalls and practices of building secure software applications. Topics will include threat modeling, secure software development, defensive programming, web security, and the interaction between security and usability. The course focuses on the application level with minor attention to operating-system level security; network-level security is not covered. Assignments involve designing and implementing secure software, evaluating designs and systems for security-related flaws, and presentations on security issues or tools. All students will be required to sign a pledge of responsible conduct at the start of the course.

Department
Computer Science
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
CS3013 and CS3733. The course assumes nontrivial experience with C and Unix, familiarity with operating systems, filesystems, and databases, and experience with technologies for building web applications (from CS4241 or personal experience).

CS 4404 : Tools and Techniques in Computer Network Security

This course introduces students to modern network security concepts, tools, and techniques. The course covers security threats, attacks, and mitigations at the operating-system and network levels (as opposed to the software level). Topics include authentication, authorization, confidentiality, integrity, anonymity, privacy, intrusion detection and response, and cryptographic applications. Students will become familiar with modern security protocols and tools. Assignments will involve using security-testing software to uncover vulnerabilities, network packet analyzers, and existing security applications to create secure network implementations. The course requires enough programming and systems background to understand attacks and use systems tools but does not involve significant programming projects. Assignments and projects will use a Linux base for implementation.

Department
Computer Science
Category
Category II (offered at least every other Year)
Units 1/3
Recommended Background
Knowledge of operating systems (CS 3013 or equivalent) and computer networks (CS 3516 or equivalent). Familiarity with Linux or Unix is essential.

CS 4432 : Database Systems II

This course concentrates on the study of the internals of database management systems. Topics include principles and theories of physical storage management, advanced query languages, query processing and optimization, index structures for relational databases, transaction processing, concurrency control, distributed databases, and database recovery, security, client server and transaction processing systems. Students may be expected to design and implement software components that make up modern database systems. Undergraduate credit may not be earned both for this course and CS 542. This course will be offered in 2021-22, and in alternating years thereafter.

Department
Computer Science
Category
Category II (offered at least every other Year)
Units 1/3
Recommended Background
CS 3431 and CS 3733.

CS 4433/DS 4433 : Big Data Management and Analytics

This course introduces the emerging techniques and infrastructures for big data management and analytics including parallel and distributed database systems, map-reduce, Spark, and NoSQL infrastructures, data stream processing systems, scalable analytics and mining, and cloud-based computing. Query processing and optimization, access methods, and storage layouts developed on these infrastructures will be covered. Students are expected to engage in hands-on projects using one or more of these technologies.

Department
Computer Science
Data Science
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
Knowledge in database systems at the level of CS4432, and programming experience are assumed.

CS 4445 : Data Mining and Knowledge Discovery in Databases

This course provides an introduction to Knowledge Discovery in Databases (KDD) and Data Mining. KDD deals with data integration techniques and with the discovery, interpretation, and visualization of patterns in large collections of data. Topics covered in this course include data warehousing and mediation techniques; data mining methods such as rule-based learning, decision trees, association rules, and sequence mining; and data visualization. The work discussed originates in the fields of artificial intelligence, machine learning, statistical data analysis, data visualization, databases, and information retrieval. Several scientific and industrial applications of KDD will be studied. This course will be offered in 2021-22, and in alternating years thereafter.

Department
Computer Science
Category
Category II (offered at least every other Year)
Units 1/3
Recommended Background
MA 2611, CS 2223, and CS 3431 or CS 3733.

CS 4513 : Distributed Computing Systems

This course extends the study of the design and implementation of operating systems begun in CS 3013 to distributed and advanced computer systems. Topics include principles and theories of resource allocation, file systems, protection schemes, and performance evaluation as they relate to distributed and advanced computer systems. Students may be expected to design and implement programs that emphasize the concepts of file systems and distributed computing systems using current tools and languages. Undergraduate credit may not be earned both for this course and for CS 502. This course will be offered in 2021-22, and in alternating years thereafter.

Department
Computer Science
Category
Category II (offered at least every other Year)
Units 1/3
Recommended Background
CS 3013, CS 3516, and system programming experience.

CS 4515 : Computer Architecture

This course explores the architectural design of modern computer systems in terms of instruction sets and the organization of processors, controllers, memories, devices, and communication links. Topics include an overview of computer architectures and system components, theoretical foundations, instruction-level and thread-level pipelining, multifunction pipelines, multi-core systems, caching and memory hierarchies, and multi-core and parallel computer organization. Students may be expected to design and implement programs that simulate significant components of modern computer architectures. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Computer Science

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

CS 2011 or ECE 2049, and CS 3013.

CS 4516 : Advanced Computer Networks

This course provides an in-depth look into computer networks. While repeating some of the areas from CS 3516, the goal is to go deeper into computer networks topics. This in-depth treatment in topics such as routing, congestion control, wireless layer protocols, and physical signaling considerations will require the use of basic queuing theory and probability to provide a more formal treatment of computer networks performance. Other topics covered include LAN and WLAN technologies, mobile wireless networks, sensor networks, optical networks, network security, intrusion detection, and network management. Students will be expected to do more sophisticated network programming than seen in CS 3516 and will conduct laboratory activities involving measuring the performance of modern networking applications running on both wired networks and infrastructure wireless networks. Undergraduate credit may not be earned both for this course and for CS 513. This course will be offered in 2021-22, and in alternating years thereafter.

Department

Computer Science

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

CS 3013, CS 3516, and knowledge of probability. The course assumes a familiarity with operating systems including Unix or Linux and significant experience with C/C++.

CS 4518 : Mobile and Ubiquitous Computing

The goal of this course is to acquaint students with fundamental concepts and state-of-the-art computer science literature in mobile and ubiquitous computing. Topics to be covered include mobile systems issues, human activity and emotion sensing, location sensing, mobile human-computer interaction, mobile social networking, mobile health, power saving techniques, energy and mobile performance measurement studies, and mobile security. The course will introduce the programming of mobile devices such as smartphones running the Android operating system. Students may not earn credit for both CS 403X and CS 4518.

Department

Computer Science

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

Proficiency in programming in Java, including classes, inheritance, exceptions, interfaces, and polymorphism (CS 2102 or equivalent).

CS 4533 : Techniques of Programming Language Translation

This course studies the compiling process for high-level languages. Topics include lexical analysis, syntax analysis, semantic analysis, symbol tables, intermediate languages, optimization, code generation, and run-time systems. Students will be expected to use compiler tools to implement the front end — and to write a program to implement the back end — of a compiler for a recursive programming language. Undergraduate credit may not be earned for both this course and for CS 544. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Computer Science

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

CS 2102 or CS 2103, and CS 3133.

CS 4536 : Programming Languages

This course covers the design and implementation of programming languages. Topics include data structures for representing programming languages, implementing control structures (such as functions, recursion, and exceptions), garbage collection, and type systems. Students will be expected to implement several small languages using a functional programming language. Undergraduate credit may not be earned for both this course and CS 536. This course will be offered in 2021-22, and in alternating years thereafter.

Department

Computer Science

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

CS 2303, CS 3133, and experience programming in a functional language (as provided by CS 1101 or CS 1102).

CS 4731 : Computer Graphics

This course studies the use of the computer to model and graphically render two- and three-dimensional structures. Topics include graphics devices and languages, 2- and 3-D object representations, and various aspects of rendering realistic images. Students will be expected to implement programs which span all stages of the 3-D graphics pipeline, including clipping, projection, arbitrary viewing, hidden surface removal, and shading. Undergraduate credit may not be earned both for this course and for CS 543.

Department

Computer Science

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

CS 2223, CS 2303, and MA 2071.

CS 4732 : Computer Animation

This course provides an in-depth examination of the algorithms, data structures, and techniques used in modeling and rendering dynamic scenes. Topics include animation hardware and software; parametric blending techniques; modeling physical and articulated objects; forward and inverse kinematics; key-frame, procedural, and behavioral animation; and free-form deformation. Students will be expected to develop programs to implement low-level animation algorithms as well as use commercial animation tools to design and produce small- to moderately-sized animations. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Computer Science

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

CS 4731.

CS 4801/ECE 4802 : Introduction to Cryptography and Communication Security

This course provides an introduction to modern cryptography and communication security. It focuses on how cryptographic algorithms and protocols work and how to use them. The course covers the concepts of block ciphers and message authentication codes, public key encryption, digital signatures, and key establishment, as well as common examples and uses of such schemes, including the AES, RSA-OAEP, and the Digital Signature Algorithm. Basic cryptanalytic techniques and examples of practical security solutions are explored to understand how to design and evaluate modern security solutions. The course is suited for students interested in cryptography or other security related fields such as trusted computing, network and OS security, or general IT security.

Department

Computer Science
Electrical and Computer Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Experience in expressing algorithms in a modern programming language (e.g., ECE 2049 or CS 2301). ECE 2049 (Embedded Computing in Engineering Design) or CS 2301 (Systems Programming for Non-Majors) or equivalent.

Suggested

Discrete mathematics (CS 2022/MA 2201 or equivalent)

CS 4804 : Data Visualization

This course trains students in data visualization, the graphical communication of data and information for presentation, confirmation, and exploration. Students learn the stages of the visualization pipeline, including data characterization, mapping data attributes to graphical attributes, user task abstraction, visual display techniques, tools, paradigms, and perceptual issues. Students evaluate the effectiveness of visualizations for specific data, task, and user types. Students implement visualization algorithms and undertake projects involving the use of commercial and public-domain visualization tools.

Department

Data Science
Computer Science

Units 1/3

Recommended Background

CS 2102 or CS 2103, and CS 2223.

Geosciences

GE 2341 : Geology

Students of this course will examine the fundamental principles of physical geology including the materials, structures, and surface features of the earth and the processes which produced them. Emphasis will be placed on the interrelationship of people and environment and applications to various fields of technology. The course includes field trips and a significant laboratory component.

Department

Geosciences

Category

Category I (offered at least 1x per Year)

Units 1/3

Humanities & Arts

EN 3257 : Topics in African American Literature

This course offers a deep exploration of the vibrancy of Black American life and thought through the lens of African American literature. Students will actively and critically read selected African American texts considering the historical contexts in which they were produced as well as analyzing their formal elements. While the course will focus on Black American experience in the United States, it will do so in dialogue with the larger diasporic Black experience. The topics will rotate regularly, alternating between close examination of different authors, genres, themes, or movements while preparing students for the HUA capstone experience. Examples of authors are Langston Hughes, Richard Wright, James Baldwin, Zora
Neale Hurston, Alice Walker, Toni Morrison, Lorraine Hansberry and August Wilson. Examples of genres are slave narratives, sermons, autobiographies, dramas, spirituals, blues, and drama. Examples of themes are race and the law, freedom struggles, and intersections between race and class, gender, and sexuality. Examples of movements are the Black Arts Movement, the Civil Rights Movement, and the Black Lives Matter Movement. Faculty offering the course will indicate which authors, genres or themes they intend to present on the HUA website well before student signups. This course may be repeated for different topics.

Department

Humanities & Arts

Category

Category II (offered at least every other Year)

Units 1/3

HI 1333 : Introduction to American Histories of Protest and Power

Why do people organize and protest to change the world around them? This course takes a topical approach to introduce the historical questions, intersectional methods, and contemporary sources that shape the study of social movements on the political left and right. Balancing the exploration of the ideological, political, and economic roots of protest movements and the identities, strategies, and technologies that inspire individual and collective action, this course examines the varied responses that protest movements elicit from society and the structures of power from suppression to realization to cooptation. Although protests movements, such as abolitionist, populist, white supremist, Civil Rights, Black Power, feminist, gay liberation, anti-war, environmental, socialist, labor, and/or alt-Right movements, under consideration in this course will change, students can only receive credit for it once.

Department

Humanities & Arts

Category

Category I (offered at least 1x per Year)

Units 1/3

HU 1222 : Introduction to Medical Humanities

How do medicine, disease, health, and healing shape our experience of what it is to be human? What do literature, poetry, popular culture, or religious and spiritual traditions have to do with modern medical practices and institutions? This course provides an introduction to the interdisciplinary field of medical humanities, and its core set of concepts, questions, methodologies, and theoretical frameworks. The course will bring together and familiarize students with work from diverse fields of study, including comparative literature, the visual and performing arts, history of medicine, cultural studies, science and technology studies, anthropology, ethics, and philosophy. Potential course topics include the production and circulation of medical knowledge, embodied experiences of illness and affliction, cross-cultural perspectives on sickness and healing, the social and interpersonal dimensions of illness, illness and medicine in popular culture, and the ways in which humanistic inquiry can enhance and improve contemporary medical practices. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Humanities & Arts

Category

Category II (offered at least every other Year)

Units 1/3

HU 1400 : Introduction to Africana Studies

This survey course introduces students to the content and contours of Africana Studies as a discipline and highlights its genealogy, development, and future challenges. The course focuses on the black experience in its historical and current unfolding in the Americas, particularly the United States, the Caribbean, Canada, and Latin America. It also gives attention to how members of the Diaspora have engaged with Africa, and to how Africans have responded to the history of enslavement, colonialism, racism, and globalization. In this course, scholarly literature, film, music, photography, and artwork will be used to develop a critical understanding of the experience of Afro-descended peoples around the world.

Department

Humanities & Arts

Category

Category I (offered at least 1x per Year)

Units 1/3

HU 1411 : Introduction to American Studies

This interdisciplinary course introduces students to a number of basic American Studies methodologies. Emphasis will vary according to the instructor, but usually the course will cover the following: the textual and contextual analysis (at the community, national, and transnational levels) of literary works; the relationships between the literary, performing, and visual arts in a specific time period; the analysis of radio, film, television, and digital media forms at the level of production and reception; the mediation and remediation of cultural, social, and political history. This course will be offered in 2021-22, and in alternating years thereafter.

Department

Humanities & Arts

Category

Category II (offered at least every other Year)

Units 1/3

HU 1500 : Introduction to Gender, Sexuality & Women's Studies

This foundational course offers an introduction to the interdisciplinary field of gender, sexuality and women's studies. The course fosters critical examination of gender, sexuality and women and asks how the interlocking systems of oppression, including colonialism, racism, sexism, homophobia, transphobia, and ethnocentrism, shape people's lives, and how individuals and groups have worked to resist these oppressions. Potential course topics include histories of gender activism, gender, sexuality and their relationships to the law, religion, reproduction, education, technology, and mental health, globalization and transnational experiences, and the role of popular culture. No prior background is required. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Humanities & Arts

Category

Category II (offered at least every other Year)

Units 1/3

HU 2222 : Topics in Medical Humanities

Topics in Medical Humanities provides students with opportunities to investigate the human (cultural, religious, historical, philosophical) dimensions of medicine, illness, and healing, from various perspectives in the humanities. Specific themes and topics will vary by section and instructor, and may include both historical and contemporary concerns, consideration of local, national, and/or global scales, and interdisciplinary methods and pedagogies drawn from a range of fields, such as comparative literature, the visual and performing arts, history of medicine, cultural studies, science and technology studies, anthropology, ethics, and philosophy. Students will analyze interactions between human beings and their environments, the production and circulation of medical and psychiatric knowledge, and historical, sociological, artistic, and literary considerations of medicine, health, and healing. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Humanities & Arts

Category

Category II (offered at least every other Year)

Units 1/3

HU 2251 : Introduction to Film Studies

This course provides an introductory window into the history and theory of film, and may cover genres from short films, silent films, animated films, documentary films, and experimental films to historical and literary adaptations, science fiction films, screwball comedies, thrillers, and westerns. In addition, attention may be given to representative directors, significant theories of film, national traditions of filmmaking, and recent convergences between film forms and digital media. Directors covered may include Charlie Chaplin, John Ford, and Alfred Hitchcock. Film theorists covered may include Stanley Cavell, Sergei Eisenstein, and Trinh T. Minh-ha. This course will be offered in 2022-23 and in alternating years thereafter.

Department
Humanities & Arts
Category
Category II (offered at least every other Year)
Units 1/3
Recommended Background
None.

HU 2258 : World Cinemas

This course will examine works of film from multiple continents, drawing on film criticism and theory and attending to the development of film industries in several different cultural contexts and national traditions. Some iterations may turn on a broader survey, others on more particular engagements with wider inflections. For example, an offering emphasizing African film might attend not only to films made on the African continent but also to films emerging from the African diaspora in the Americas, and an offering emphasizing Italian film would also attend not only to the films made on the Italian peninsula but also to films emerging from the Italian diaspora in Australia and the United States. This course will be offered in 2021-2022, and in alternating years thereafter.

Department
Humanities & Arts
Category
Category II (offered at least every other Year)
Units 1/3
Recommended Background
None, though HU 2251: Introduction to Film Studies will serve as useful preparation.

HU 2501 : STEM-inism

The study and practice of STEM-inism centers the equal participation and representation of all social groups in the fields of science, technology, engineering, and math (STEM). In particular, this course highlights the concepts, theories, and practices of feminism into its understanding of STEM-inism as a field of inquiry. This course provides an overview of the history of female and non-binary contributors and contributions to this field of study and practice, ranging from Hypatia to Ada Lovelace to NASA visionary Katherine Johnson to queer and trans STEM visionaries Martine Rothblatt, Joan Roughgarden, and Lynn Conway. This course may also consider the following topics: the gender gap in STEM fields, biases in medical research, sexual harassment, eugenics, reproductive justice, transgender rights, and contemporary social movements. The course will also incorporate a deliberate analysis of intersecting identity categories, including race, class, sexuality, religion, and ability. This course will be offered in 2022-23, and in alternating years thereafter.

Department
Humanities & Arts
Category
Category II (offered at least every other Year)
Units 1/3

HU 2502 : Global Feminisms

Bringing together transnational, postcolonial, and indigenous feminist and queer lines of thought, this course provides a global perspective on the interdisciplinary field of gender, sexuality, and women's studies. Motivated by the idea that marginalized peoples - including women, those who identify as non-binary, and ethnic, religious, and economic minorities - share common experiences of exclusion and common stories of resistance, this course fosters critical examination of the relationship between gender, sexuality, feminism, colonialism, and racism. It may consider this intersection through case studies from Africa, Asia, Latin America, and the Middle East with particular attention to places that host WPI project centers. This course will be offered in 2021-22, and in alternating years thereafter.

Department

Humanities & Arts

Category

Category II (offered at least every other Year)

Units 1/3

HU 2900 : Humanities and Arts Project Preparation

This course is required of students accepted to off-campus Humanities and Arts centers and programs. The course introduces students to methods for site-specific research, project-design, and analysis related to humanities and arts study. It also develops HUA disciplinary skills appropriate both to the projects students have selected and to the culture of the project center where they will be working. Students learn to develop project objectives, milestones, and deliverables in their topic areas related to their forthcoming onsite work and expectations. Students make presentations, write an organized project proposal, and develop a deliverable design for reporting their project findings. This course is a pre-requisite for off-campus Humanities and Arts project center study only. This credit will not count toward the Humanities and Arts requirement.

Department

Humanities & Arts

Category

Category I (offered at least 1x per Year)

Units 1/6

Recommended Background

none.

HU 2901 : Topics in Sexuality and LGBTQ+ Studies

This course uses interdisciplinary, thematic, and case study approaches to explore sexuality in the modern world. It takes as its starting point the understanding that sex and power are interrelated and that they manifest differently in different social and cultural contexts (including spaces and places to which WPI students may travel as part of their global projects experience). Further, this course recognizes that the categorization, experiences, and treatment of queer persons and bodies and non-normative sexuality have changed over time and space, as have sexual mores and conceptualizations of "purity" and "deviance," which are linked to class, race, dis/ability, and power relations within and between states. This course may include the study of the history of sexuality in the United States and globally; national and international activism around sexual liberation and LGBTQ+ pride; religion and sexuality; the relationship of LGBTQ+ activism to other civil rights movements; sex work; sexual violence; cultural representations of queer and non-normative sexualities, and "anti-genderism" and authoritarian populism. The expected enrollment is 20, and the course type is Lecture/Discussion. This course may be repeated for different topics.

Department

Humanities & Arts

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

None

HU 2910 : Project Center Experiential Learning

This course will provide students participating in a HUA Project Center with a framework for investigating a particular cultural site, and to define a unique set of humanities and arts learning goals through experiential learning. Experiential learning means learning from experience or learning by doing. Experiential education immerses learners in an experience and then encourages reflection about the experience to develop new skills, new attitudes, or new ways of thinking. This course is structured in a self-directed manner in which students select a humanities/arts topic or theme, explore and experience arts and cultural sites related to that theme, then engage in self-reflection and self-evaluation of their learning.

Department

Humanities & Arts

Category

Category III (offered at discretion of dept/prgm)

Units 1/3

HU 3900 : Inquiry Seminar in Humanities and Arts

This seminar serves as the culmination for a student's Humanities and Arts Requirement. The seminar provides opportunities for sustained critical inquiry into a focused thematic area. The seminar seeks to help students learn to communicate effectively, to think critically, and to appreciate diverse perspectives in a spirit of openness and cooperation through research, creativity, and investigation. The specific theme of each seminar will vary and will be defined by the instructor. Prior to enrolling in the seminar, a student must have completed five courses in Humanities and Arts, at least two of which must be thematically related and at least one of which must be at the 2000-level or above.

Department

Humanities & Arts

Category

Category I (offered at least 1x per Year)

Units 1/3

HU 3910 : Practicum in Humanities and Arts

The practicum serves as the culmination for a student's Humanities and Arts Requirement. The practicum provides opportunities for sustained critical inquiry into a focused thematic area. The practicum seeks to help students learn to communicate effectively, to think critically, and to appreciate diverse perspectives in a spirit of openness and cooperation through research, creativity, and investigation. The specific theme of each practicum will vary and will be defined by the instructor. Prior to enrolling in the practicum, a student must have completed five courses in Humanities and Arts, at least two of which must be thematically related and at least one of which must be at the 2000-level or above. Consent of the instructor is required for enrollment.

Department

Humanities & Arts

Category

Category I (offered at least 1x per Year)

Units 1/3

HU—AAS-50 : American Antiquarian Seminar

Each fall the American Antiquarian Society and five Worcester colleges sponsor a research seminar at the Antiquarian Society library. The seminar is conducted by a scholar familiar with the Society's holdings in early American history, and the seminar topic is related to his or her field of research. Selection is highly competitive. The ten participating students are chosen by a screening committee made up of representatives of the five participating colleges: Assumption College, Clark University, College of the Holy Cross, WPI, and Worcester State College. The seminar topic and research methods combine several disciplines, and students from a wide variety of majors have participated successfully in this unique undergraduate opportunity.

Department

Humanities & Arts

Units 1/3

Arabic

AB 1531 : Elementary Arabic I

This course introduces students with no prior Arabic experience to Modern Standard Arabic and Darija, the Arabic dialect spoken in Morocco. The course sets the foundation for subsequent courses; it introduces students to pivotal aspects of Arabic, including the Arabic script and sound system. Along the way, students learn common vocabulary used in formal contexts, common phrases and greetings as well as aspects of Arab cultures.

This course is open to students with no Arabic language background; *this course is closed to native speakers of Arabic and heritage speakers except with written permission from the instructor.*

Department
Arabic
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
None.

AB 1532 : Elementary Arabic II

This course continues students' exposure to and development of Modern Standard Arabic and Darija, the Arabic dialect spoken in Morocco; it is for students who can read and write using the Arabic script but have very basic understanding of vocabulary and syntax. New language structures, vocabulary and cultural concepts will be presented in communicative activities/materials in class and homework assignments; these activities will focus on receptive (reading & listening) and productive (writing & speaking) skills in Arabic.

Department
Arabic
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
AB 1531 or instructor approval; *this course is closed to native speakers of Arabic and heritage speakers except with written permission from the instructor.*

AB 1533 : Elementary Arabic III

This course is a continuation of AB 1532. Emphasis will be on building and strengthening receptive and productive skills in both Modern Standard Arabic and Darija, the Arabic dialect spoken in Morocco. Grammatical structures covered in the previous courses along with new structures will be part of class activities as well as homework assignments. Cultural aspects of Arabic-speaking countries will be introduced through course materials including commonly used vocabulary and expressions.
Department
Arabic
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
AB 1531 & AB 1532 or instructor approval; *this course is closed to native speakers of Arabic and heritage speakers except with written permission from the instructor.*

AB 2531 : Intermediate Arabic I

This course builds on the knowledge and skills that students learn in the elementary level courses (AB 1531, AB 1532 and AB 1533). Students continue learning Modern Standard Arabic with moderate exposure to phrases and expressions in Darija, Moroccan colloquial Arabic. The course employs a student-centered approach that focuses on receptive language skills (reading and listening) and productive language skills (speaking and writing); it also integrates culture and authentic materials in order to create real-life opportunities for language practice/use and to develop students' cultural competency. By the end of this course, students should be able to use tense appropriately to describe actions and events, describe their daily routines, describe personal and professional relations and report bibliographical and general information. Course assignments include daily homework, short quizzes, skits, presentations and/or an oral exam.
Students cannot receive credit for both AB 210X and AB 2531.

Department
Arabic
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
AB 1531, AB 1532 & AB 1533 or instructor approval; *this course is closed to native speakers of Arabic and heritage speakers except with written permission from the instructor.*

AB 2532 : Intermediate Arabic II

This course is a continuation of AB 2531. Students continue learning Modern Standard Arabic (MSA) with limited exposure to phrases and expressions in Darija, Moroccan colloquial Arabic. The course employs a student-centered approach that focuses on receptive language skills (reading and listening) and productive language skills (speaking and writing); it also integrates culture and authentic materials in order to create real-life opportunities for language practice/use and to develop students' cultural competency. By the end of this course, students should be able to read and understand the gist of authentic texts in MSA, answer basic comprehension questions, differentiate between parts of speech and use parts of speech to reproduce or produce short texts in MSA. Course assignments include daily homework, short quizzes, skits, presentations and/or an oral exam.
Students cannot receive credit for both AB 220X and AB 2532.

Department
Arabic
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
AB 1531, AB 1532, AB 1533 & AB 2531 or instructor approval; *this course is closed to native speakers of Arabic and heritage speakers except with written permission from the instructor.*

AB 2533 : Intermediate Arabic III

This course is a continuation of AB 2531 and AB 2532; it focuses on improving students' skills in Modern Standard Arabic (MSA). The course employs a student-centered approach that focuses on receptive language skills (reading and listening) and productive language skills (speaking and writing); it also integrates culture and authentic materials in order to create reallife opportunities for language practice/use and to develop students' cultural competency. By the end of this course, students should be able to read and understand selected authentic texts written in MSA, differentiate between main ideas and supporting ideas, answer level-appropriate comprehension questions, respond to level-appropriate open-ended questions in MSA and generate content that is level adequate. Course assignments include daily homework, short quizzes, skits, presentations and/or an oral exam.
Students cannot receive credit for both AB 230X and AB 2533.

Department
Arabic
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
AB 1531, AB 1532, AB 1533, AB 2531 & AB 2532 or instructor approval; *this course is closed to native speakers of Arabic and heritage speakers except with written permission from the instructor.*

Art History/Architecture

AR 1100 : Essentials of Art

This course provides an introduction to the basic principles of two and three-dimensional visual organization. The course focuses on graphic expression, idea development, and visual literacy. Students will be expected to master basic rendering skills, perspective drawing, concept art, and storyboarding through traditional and/or computer-based tools.

Department
Art History/Architecture
Category
Category I (offered at least 1x per Year)
Units 1/3

AR 1101 : Digital Imaging and Computer Art

This course focuses on the methods, procedures and techniques of creating and manipulating images through electronic and digital means. Students will develop an understanding of image alteration. Topics may include color theory, displays, modeling, shading, and visual perception.

Department
Art History/Architecture
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
AR 1100.

AR 1111 : Introduction to Art History

How do we understand a work of art? Through readings and the study of objects at the Worcester Art Museum, the student will survey the major developments in world art and be introduced to various critical perspectives in art history. Students will learn how art historians work with primary materials and formulate arguments. No previous knowledge of art is required. (Formerly HU 1014.)

Department
Art History/Architecture
Category
Category I (offered at least 1x per Year)
Units 1/3

AR 2048/IMGD 2048 : Technical Art and Character Rigging

This course will focus on making digital art functional in a video game environment. Students will learn the skills necessary to create and optimize their art assets through several creative and technical solutions that are all geared towards making high quality game art. This course will allow students to form a greater understanding of the bridge between pure art creation and interactive art implementation into a game engine. The course explores the many problems and technical restrictions one is faced with when trying to implement anything from animated characters to textures and focuses on how one can creatively apply technology to achieve high quality results. Topics covered include: creating complex character rigs, optimizing character meshes for rigging, shader creation, optimizing UV space and baking texture files and lighting.

Department

Interactive Media and Game Development
Art History/Architecture

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

Basic knowledge of 3D modeling, texturing and animation (IMGD 2101 and IMGD 2201 or equivalent).

AR 2101/IMGD 2101 : 3D Modeling I

3D modeling is concerned with how to render created forms in a virtual environment. This course covers 3D modeling applications in video game development, film production, product design and fine art. Topics may include creating and armature, modeling organic and hard surfaces and sculpting using traditional techniques applied to a 3D model. Students will create works suitable for presentation in professional quality portfolio.

Department

Art History/Architecture
Interactive Media and Game Development

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

AR 1100 and AR 1101.

AR 2111 : Modern Art

The successive phases of modern art, especially painting, are examined in light of the late-19th-century break with the 600-year old tradition of representation. Topics covered include: non-objective art and abstraction—theory and practice, primitivism in modern art, surrealism and the irrational, the impact of photography on modern painting, cubism and collage, regionalism and abstract expressionism as American art forms, Pop art and popular culture, and the problem of concept versus representation in art. (Formerly AR 2300.)

Department

Art History/Architecture

Category

Category I (offered at least 1x per Year)

Units 1/3

AR 2114 : Modern Architecture in the American Era, 1750-2001 and Beyond

This course studies, in a non-technical way, Americas buildings and places, in the context of world architecture in modern times. The history of American architecture was shaped by the forces that shaped America, from its political emergence in the eighteenth century to the post-9/11 era. These forces include dreams of social and spiritual perfection; a tight and conflicted relation with nature; and the rise and spread of industrial capitalism. The same forces created the Modern Movement in architecture. How are modernism and American architecture interrelated? Illustrated lectures, films, and tours of Worcester architecture explore the question, while training students in the methods of architectural history and criticism. Students who have taken AR 2113, Topics in 19th- and 20th-Century Architecture, since the 2000-2001 academic year MAY NOT take AR 2114 for credit.

Department

Art History/Architecture

Category

Category I (offered at least 1x per Year)

Units 1/3

AR 2115 : Topics in Architecture Since 1960

This course offers a detailed overview of the history of architecture between the consolidation of modern architecture in standard architectural practice and the present period of pluralism. Topics covered will include: modernism and its critique in the developing world; Louis I. Kahn's and Robert Venturi's critiques of modernist architecture culture; the High-Tech movement; utopian alternatives to the modernist city; the return of pre-modern urbanism; Critical Regionalism; the rise of Postmodernism 1970-80; the developer-led architectural boom of the 1980s; "Deconstructivism" and critical dissolution of rationalist form; the introduction of CAD in architectural design and its impact on the "blob architecture" of Frank Gehry and others; the development of global models of architectural practice; sustainable architecture and urbanism; global developments in other, related design fields and their consumer culture.

Department
Art History/Architecture
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
AR 2114.

AR 2202 : Figure Drawing

The focus of this course is in study of representational figure drawing. This course will cover drawing techniques, applied to study from a live model. Topics covered will be sight size measurement, study of form and light, copying from master drawings and applying these lessons to weekly sessions with a live model. Each class will feature a demonstration on the topic followed by individual critique and study.

Department
Art History/Architecture
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
AR 1100.

AR 2222/IMGD 2222 : 2D Animation I

2D Animation I teaches students how to draw, pose, breakdown and in-between characters for 2D animation, focusing on weight, balance, timing, and movement to achieve well-structured and fluid animation. Lectures and projects are conducted to train students in the twelve classical animation principles using digital 2D media. Projects and lectures are designed to practice the fundamentals of traditional frame-by-frame and hand-drawn character animation.

Department
Art History/Architecture
Interactive Media and Game Development
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
Basic knowledge of figure drawing (AR 2202) and digital art software (AR 1101) is recommended.

AR 2301 : Graphic Design

This course introduces design principles and their application to create effective forms of graphic communication. The students will learn the fundamentals of visual communication and will work on projects to analyze, organize, and solve design problems. Topics may include: the design process; figure/ground; shape; dynamic balance; Gestalt principles; typography; layout and composition; color; production and presentation in digital formats.

Department
Art History/Architecture
Category
Category I (offered at least 1x per Year)
Units 1/3

AR 2333/IMGD 2333 : 3D Animation I

3D Animation I teaches students how to use 3D animation software to apply classical animation principles into 3D work. Lectures focus on creating organic and compelling character animation through body mechanics, weight, and dynamic posing in addition to exposing students to learning how to think about character acting and staging within a 3D environment.

Department

Art History/Architecture
Interactive Media and Game Development

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Basic knowledge digital art software (AR 1101) is recommended.

Suggested

Basic knowledge of animation (IMGD 2222/AR 2222).

AR 2401 : Video Production

This course will introduce students to concepts and techniques for live action digital filmmaking. Topics will include constructing a visual narrative, principles of cinematography, visual and audio editing, working with actors, and the stylistic elements of various genres of filmmaking.

Department

Art History/Architecture

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Basic knowledge of the history and theory of film (HU 2231 or equivalent).

AR 2700/IMGD 2700 : Digital Painting

This course covers painting techniques as applied to texturing a 3D asset or illustration/conceptual art. Topics include are color theory, study of form, lighting, applying traditional painting ideas to the digital format, character design, generation of ideas and a history of digital painting. Each class features a demonstration on the topic followed by individual critique and study. Students work towards a final project that may be suitable for an Art portfolio.

Department

Art History/Architecture
Interactive Media and Game Development

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

AR 1101 (Digital imaging and Computer Art); AR 2202 (Figure Drawing)

AR 2740/IMGD 2740 : 3D Environmental Modeling

The objective of this course is to teach students how to create 3D environments and props for use in digital models, simulations, games, or animation. The course will examine different types of architecture used in 3D spaces. The students will learn how to create historical and fictional interior and exterior environments; to design, model, texture, and render in high details; and to import their creation into an engine for testing. Topics may include space, human scale, set design, surface texturing, and basic camera animation. Students may not receive credit for IMGD/AR 2740 and IMGD/AR 205X. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Art History/Architecture
Interactive Media and Game Development

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

Basic 3D modeling skills (AR 1101)

AR 2750 : Topics in Studio Art

Specialty subjects are offered using the research and creative expertise of the department faculty. Content and format varies to suit the interest and needs of the faculty and students. Courses are defined through the registrar and may be repeated for different topics covered. Students may not receive additional credit for taking this course more than once with the same title.

Department
Art History/Architecture
Category
Category III (offered at discretion of dept/prgm)
Units 1/3
Recommended Background
AR 1100

AR 3101/IMGD 3101 : 3D Modeling II

This course will build upon the skills learned in 3D MODELING with studies in life drawing/anatomy study and application towards completed character models. Students will create high resolution sculpts for real time game environments and animation. Topics covered will be character design as it applies to 3D MODELING, creating realistic design sculpts and incorporating them into a game environment as well as the study of anatomy as it applies to organic modeling.

Department
Art History/Architecture
Interactive Media and Game Development
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
AR 1101, IMGD 2101/AR 2101, AR 2202

AR 3112 : Modernism, Mass Culture, and the Avant-Garde

What is the role of art to be in the modern world? Can art be a vehicle for social change, or should art be a self-critical discipline that pursues primarily aesthetic ends? What is the relationship between art and mass culture? Using primary sources, this course focuses on some of the theorists and artistic trends since the mid-nineteenth century that have sought to resolve this dilemma. These include: Ruskin, Morris and the Arts and Crafts Movement; Art for Art's Sake; the German Werkbund and the Bauhaus; American industrial design.

Department
Art History/Architecture
Category
Category I (offered at least 1x per Year)
Units 1/3

AR 3150/ID 3150 : Light, Vision and Understanding

By using material from the sciences and the humanities, this course examines the ways in which ideas of knowledge and of human nature have been fashioned. The specific topics include physical theories about light, biological and psychological theories of visual perception, and artistic theories and practices concerned with representation. The mixing of material from different academic disciplines is deliberate, and meant to counter the notion that human pursuits are "naturally" arranged in the neat packages found in the modern university. The course draws upon the physical and social sciences, and the humanities, to examine how those fields relate to one another, and how they produce knowledge and self-knowledge. Cultural as well as disciplinary factors are assessed in this process. Light, Vision and Understanding is conducted as a seminar. The diverse collection of reading materials includes a number of primary texts in different fields. In addition, the students keep a journal in which they record the results of numerous individual observations and experiments concerning light and visual perception. The course can fit into several Humanities and Arts topic areas as well as serve as a starting point for an IQP. There are no specific requirements for this course, although some knowledge of college-level physics, as well an acquaintance with the visual arts, is helpful. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Art History/Architecture
Integrative & Global Studies

Category

Category II (offered at least every other Year)

Units 1/3

AR 3200/IMGD 3200 : Interactive Electronic Arts

This course introduces students to techniques and processes for the creation of real-time, interactive works of art. Students learn to use electronic sensors and other tools for audio, graphics, and video processing, as well as design customized software interfaces to create interactive artworks that respond to users and their environment. The course also introduces students to the work of significant contemporary arts practitioners as well as their historical precedents, with a special emphasis on inter-media works that bridge visual art, music composition, and the performing arts. Topics may include electronic musical instruments and performance interfaces, computer vision, VJing, electronically-augmented dance, controller hacking, wired clothing, networked collaboration and mobile media, and algorithmic and generative art.

Department

Art History/Architecture
Interactive Media and Game Development

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Animation (AR 2101/IMGD 2101 or equivalent), and exposure to digital audio or music and introductory programming.

AR 3210/IMGD 3210 : Human Figure in Motion

This course offers in-depth analysis of the human figure in action. Motion is analyzed and studied through drawing and sketching of live models, video clips, performance and pantomime, studying not only the physical exterior but also how thoughts and emotion are expressed through gesture. Students will develop skill in figure posing and staging for applications in animation, storyboards, comics, and illustration.
This course will be offered in 2021-22, and in alternating years thereafter.

Department

Art History/Architecture
Interactive Media and Game Development

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

Observational and gesture drawing and color (AR 1101), experience drawing live model (AR 2202), composition skills and color (AR 2700/IMGD 2700).

AR 3222/IMGD 3222 : 2D Animation II

This course will build upon the techniques learned in AR 2222/IMGD 2222. Students will learn to apply the animation principles to character animation. Students are taught how to tell a compelling, character-driven story through a focus on character acting techniques such as body language, lip syncing, facial animation, and micro expressions. Additional topics covered may include sprites for games, biped and quadruped animation, and 2D animation pipelines. Students will create animated sequences that are intended to serve a narrative structure for games and other media.

Department

Art History/Architecture
Interactive Media and Game Development

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Knowledge of digital 2D animation techniques and classical animation principles (IMGD/AR 2222).

AR 3333/IMGD 3333 : 3D Animation II

This course will build upon the techniques learned in IMGD/AR 2333. Students will learn to apply the animation principles with a focus on character acting and cinematic animation. Students are taught how to tell a compelling, character-driven story through a focus on acting techniques such as body language, lip syncing, facial animation, and micro expressions whilst incorporating digital cinematography techniques. Additional topics covered may include creating 3D simulations for hair and cloth, biped and quadruped animation, and 3D animation pipelines. Students will create animated sequences that are intended to serve a narrative structure for games and other media.

Department

Art History/Architecture
Interactive Media and Game Development

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Knowledge of digital 3D animation techniques and classical animation principles (AR 2333/IMGD 2333).

AR 3700/IMGD 3700 : Concept Art and Creative Illustration

This course covers drawing as it applies to concept art and illustration. The course begins with study of a human model and representational drawing. Following this, students work on drawing from the mind and applying the lessons learned from the figure drawing to creating concept art and illustration. Topics covered are shape recognition and recalling, inventing from the mind, creative starters, study of form and light, visual composition and developing a personal approach, working with individual strengths to create a compelling visual design. Students create a series of concept art exercises and apply these skills towards a personal project of their own.

Department

Art History/Architecture
Interactive Media and Game Development

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

AR 2202 (Figure Drawing); AR 2700/ IMGD 2700 (Digital Painting)

Chinese

CN 1541 : Elementary Chinese I

An intensive course to introduce Mandarin Chinese to students with no or little background in Chinese. Pronunciation, basic grammar rules, and character recognition will be the emphasis of the course. Handwriting of Chinese characters is not emphasized at this stage, and students are encouraged to typewrite the characters. Major aspects of Chinese culture will be introduced throughout the course. Students who have taken Chinese in high school are urged to take a placement test before enrolling in Elementary Chinese I.
This course is closed to native speakers of Chinese and heritage speakers, except with written permission from the coordinator of the Chinese track.

Department
Chinese
Category
Category I (offered at least 1x per Year)
Units 1/3

CN 1542 : Elementary Chinese II

A continuation of Elementary Chinese I, with progressive expansion of vocabulary and grammar. Pronunciation, basic grammar rules, and character recognition will continue to be the emphasis of the course. Handwriting of Chinese characters is not emphasized at this stage, and students are encouraged to typewrite the characters. Major aspects of Chinese culture will be introduced throughout the course.
This course is closed to native speakers of Chinese and heritage speakers, except with written permission from the coordinator of the Chinese track.

Department
Chinese
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
CN 1541.

CN 1543 : Elementary Chinese III

A continuation of Elementary Chinese II, with progressive expansion of vocabulary and grammar. Pronunciation, basic grammar rules, and character recognition will continue to be the emphasis of the course. Handwriting of Chinese characters is not emphasized at this stage, and students are encouraged to typewrite the characters. Major aspects of Chinese culture will be introduced throughout the course.
This course is closed to native speakers of Chinese and heritage speakers, except with written permission from the coordinator of the Chinese track.

Department
Chinese
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
CN 1542.

CN 2541 : Intermediate Chinese I

Building upon the foundation of the Elementary Chinese course series, this course is designed to expand students' skills in listening comprehension, speaking, reading, and writing. The course continues to enhance students' vocabulary and introduces more complex grammatical patterns, with more emphasis placed on improving communication skills both orally and in writing.
This course is closed to native speakers of Chinese and heritage speakers, except with written permission from the coordinator of the Chinese track.

Department
Chinese
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
CN 1543.

CN 2542 : Intermediate Chinese II

A continuation of Intermediate Chinese I. This course is designed to expand students' skills in listening comprehension, speaking, reading, and writing. The course continues to enhance students' vocabulary and introduces more complex grammatical patterns, with more emphasis placed on improving communication skills both orally and in writing.
This course is closed to native speakers of Chinese and heritage speakers, except with written permission from the coordinator of the Chinese track.
Department
Chinese
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
CN 2541.

CN 2543 : Intermediate Chinese III

A continuation of Intermediate Chinese II. This course is designed to expand students' skills in listening comprehension, speaking, reading, and writing. The course continues to enhance students' vocabulary and introduces more complex grammatical patterns, with more emphasis placed on improving communication skills both orally and in writing.
This course satisfies the Inquiry Practicum requirement.
This course is closed to native speakers of Chinese and heritage speakers, except with written permission from the coordinator of the Chinese track.
Department
Chinese
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
CN 2542.

CN 2544 : Intermediate Chinese IV

A continuation of Intermediate Chinese III. This course is designed to expand students' skills in listening comprehension, speaking, reading, and writing. The course continues to enhance students' vocabulary and introduces more complex grammatical patterns, with more emphasis placed on improving communication skills both orally and in writing. Special attention will also be given to uses of nuanced and formal expressions to prepare students for the advanced level.
This course satisfies the Inquiry Practicum requirement.
This course is closed to native speakers of Chinese and heritage speakers, except with written permission from the coordinator of the Chinese track.

Department
Chinese
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
CN 2543.

CN 3541 : Advanced Chinese I

Building upon the foundation of the Intermediate Chinese course series, this course continues to develop students' integrated skills of listening, speaking, reading, and writing to meet the demand of increasing complexity and sophisticated communication at the advanced level. Expanding on topics from the concreate to the abstract, this course equips students with appropriate linguistic and cultural knowledge and skills through interpretive, interpersonal, and presentational modes of communication.
This course satisfies the Inquiry Practicum requirement.
This course is closed to native speakers of Chinese and heritage speakers, except with written permission from the coordinator of the Chinese track.

Department
Chinese
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
CN 2544 or the equivalent.

CN 3542 : Advanced Chinese II

A continuation of Advanced Chinese I, this course continues to develop students' integrated skills of listening, speaking, reading, and writing to meet the demand of increasing complexity and sophisticated communication at the advanced level. Expanding on topics from the concrete to the abstract, this course continues to equip students with appropriate linguistic and cultural knowledge and skills through interpretive, interpersonal, and presentational modes of communication.
This course satisfies the Inquiry Practicum requirement.
This course is closed to native speakers of Chinese and heritage speakers, except with written permission from the coordinator of the Chinese track.

Department
Chinese
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
CN 3541 or equivalent.

CN 3543 : Advanced Chinese III

A continuation of Advanced Chinese II. This course continues to develop students' integrated skills of listening, speaking, reading, and writing to meet the demand of increasing complexity and sophisticated communication at the advanced level. Expanding on topics from the concreate to the abstract, this course continues to equip students with appropriate linguistic and cultural knowledge and skills through interpretive, interpersonal, and presentational modes of communication.
This course satisfies the Inquiry Practicum requirement.
This course is closed to native speakers of Chinese and heritage speakers except with written permission from the coordinator of the Chinese track.
Department
Chinese
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
CN 3542 or equivalent.

CN 3561 : Business Chinese

The objective of this content-based language course is two-fold: students with intermediate-high level and above will continue to build their language skills in business contexts through a curriculum design that incorporates interpretive, interpersonal and presentational modes of communication in the target language. Students will also acquire knowledge and understanding of how social and cultural factors come into play in doing business in China, thereby gaining sharper cultural awareness about Chinese business in the context of globalization. Course materials include actual business cases of Chinese companies as well as analysis of strategies adopted by multinational companies that have successfully entered the competitive market in China.
Students who have completed CN 356X cannot receive credit for CN 3561.
Department
Chinese
Category
Category II (offered at least every other Year)
Units 1/3
Recommended Background
This course is designed for CFL (Chinese as a Foreign Language) and CHL (Chinese as a Heritage) students who complete the prerequisite of CN 3543 or equivalent.

English

EN 1219 : Introduction to Creative Writing

In this introductory course, students will learn about the craft of writing poetry, creative nonfiction, and fiction. They will study contemporary published poems, essays, and stories written by international masters and use these texts as inspiration for their own creative work across genres. They will also read and respond to the work of their peers. Through an equally balanced studio/research approach, this course will develop students' skills as literary critics and creative writers.
Students may not receive credit for both EN 1219 and EN 121X.
Department
English
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
None

EN 1221/TH 1221 : Introduction to Theatre on Page and Stage

This introductory course gives students a basic understanding of theatrical productions and theatre vocabulary through an investigation of how a play moves from the page to the stage. By touching on the various sub-disciplines of theatre (including playwriting, design, performance, and more), this course explores the role of theatre and art in the world.

Students may not receive credit for EN 1221 & TH 1221.

Department

Theatre

English

Category

Category I (offered at least 1x per Year)

Units 1/3

EN 1222 : Shakespeare in the Age of Elizabeth

This course is an introduction to Shakespeare, his theatre, and some important concepts of his world. Students will have the opportunity to sample representative Shakespearean tragedies, comedies, and histories. In addition to class discussions and scene work, students will be able to enhance their readings by analyzing video recordings of the plays.

Department

English

Category

Category I (offered at least 1x per Year)

Units 1/3

EN 1242 : Introduction to English Poetry

This course surveys the poems of our language. From the Anglo-Saxon poems to the popular verse of Tennyson, the songs and the poets are legion: Chaucer, Raleigh, Spenser, Marlowe, Shakespeare, Jonson, Donne, Herrick, Milton, Blake, Wordsworth, Coleridge, Byron, Keats, Tennyson, Browning, and Hopkins. The England that nourished these writers will be viewed through their ballads, lyrics, sonnets, epigrams, and epics. "Not marble nor the gilded monuments of princes shall outlive this powerful rhyme."

Department

English

Category

Category I (offered at least 1x per Year)

Units 1/3

EN 1251 : Introduction to Literature

This course introduces the student to a variety of critical perspectives necessary to an understanding and appreciation of the major forms, or genres, of literary expression (e.g., novel, short story, poetry, drama, and essay). Writing and class discussion will be integral parts of this course.

Department

English

Category

Category I (offered at least 1x per Year)

Units 1/3

EN 1257 : Introduction to African American Literature and Culture

This course examines the formation and history of the African American literary tradition from slave narratives to contemporary forms in black popular culture. The course will explore some genres of African American writing and their relation to American literature and to black cultural expression. This course will be offered in 2022-23, and in alternating years thereafter.

Department

English

Category

Category II (offered at least every other Year)

Units 1/3

EN 1259 : Introduction to Contemporary Chicana/o Literature

This course examines literary works of multiple genres produced by Chicana/o writers from WWII to today, with particular emphasis on the Mexican American Civil Rights Movement of the 1960s and the contemporary relevance of issues such as land and education rights for immigrants. Writers studied may include the novelist Sandra Cisneros, the cultural critic Gloria Anzaldúa, the memoirist JP Brammer, and the short-story writer Silvia Moreno-Garcia. This course will emphasize civic involvement and will offer students the opportunity to engage with political activists and other public groups involved with immigration in America. Students cannot receive credit for both this class (EN 1259) and EN125x, Intro to Contemporary Chicana/o Literature. This course will be first offered in 2024-2025 and alternate years thereafter.

Department
English
Category
Category II (offered at least every other Year)
Units 1/3
Recommended Background
None, though introductory coursework in English (e.g. EN1251 Introduction to Literature), History (e.g. HI1312 Introduction to American Social History), or SP courses that stress literature and culture could be useful preparation

EN 2219 : Creative Writing

This foundational course in creative writing aims to help students develop or improve the skills of written expression, emphasizing presentation and discussion of original work. Offerings may include generally themed courses covering multiple genres of interest or more specialized workshops in single genres of focus such as fiction, poetry, playwriting, nonfiction, memoir, or short prose forms.

Department
English
Category
Category I (offered at least 1x per Year)
Units 1/3

EN 2225 : The Literature of Sin

This course begins with selections from John Milton's provocative version of Adam and Eve's original sin in Paradise Lost. Focusing on Milton, John Donne and others, we will examine the theme of sin—political, religious, and sexual— in early modern literature. The events of the English Reformation profoundly influenced these writers, and their personal struggles against societal institutions have greatly influenced subsequent literary expressions of rage and rebellion. Students will also be reading texts by contemporary writers such as David Mamet which address the theme of sin in the modern city. This course will be offered in 2022-23, and in alternating years thereafter.

Department
English
Category
Category II (offered at least every other Year)
Units 1/3

EN 2226 : Infected Shakespeare: Venereal Disease, Madness, Plague

With his many references to syphilis, Bubonic Plague, mental illness, and other serious afflictions, Shakespeare illuminates the harsh reality of living in 16th and 17th-century England. This course explores Shakespeare through the historical lens of early modern medical practice. Students will study plays such as Hamlet, Richard III, and The Winters Tale alongside accounts by surgeons, doctors, midwives, and others who diagnosed, dissected, and (sometimes) cured. We will also pay close attention to the superstitions, misinformation, and downright strange treatments included in some of these accounts. Through creative and expository writing, students will analyze the impact of disease on Shakespeare's writing. This course is intended for students interested in any one of the following: drama, English literature, the history of medicine, biology, other fields of life sciences. This course will be offered in 2021-22, and in alternating years thereafter.

Department
English
Category
Category II (offered at least every other Year)
Units 1/3

EN 2234 : Modern American Novel

Selected works of fiction which appeared after World War I will be the focus of this course. Ernest Hemingway, William Faulkner, or other authors of the early modern period will be studied, but significant attention will also be given to contemporary novelists, such as Thomas Pynchon, Philip K. Dick, and Toni Morrison. The cultural context and philosophical assumptions of the novels will be studied as well as their form and technique. This course will be offered in 2021-22, and in alternating years thereafter.

Department

English

Category

Category II (offered at least every other Year)

Units 1/3

EN 2237 : Literature and the Environment

This course will examine the many ways in which dramatists, essayists, filmmakers, novelists, and poets have articulated ecological and environmental concerns. Topics to be discussed may include changing attitudes towards terms like 'nature' and 'wilderness', the effects of technology on the environment, issues of conservation and sustainability, the dynamics of population growth, the treatment of animals, the production of food, and the presence of the spiritual in nature. Materials will include works by writers such as Wendell Berry, Rachel Carson, Winona LaDuke, Wangari Maathai, Thomas Malthus, Arne Naess, Nicolas Roeg, and Gary Snyder. This course will be offered in 2022-23, and in alternating years thereafter.

Department

English

Category

Category II (offered at least every other Year)

Units 1/3

EN 2242 : Popular Fiction: Reading in Installments

Students in this course will have the opportunity to read two major masterpieces of English fiction the way they should be read: slowly, carefully, and with relish. Victorian novels are long and the term is short, but by reading novels in the way in which they were read by their original readers—serially—we can experience masterworks by Charles Dickens and George Eliot at comparative leisure, examining one serial installment in each hour of class.

Department

English

Category

Category I (offered at least 1x per Year)

Units 1/3

EN 2243 : Modern British Literature

A survey of major modern British authors. The works of many of these writers reflect the political, religious, and social issues of the twentieth century. New psychological insights run parallel with experiments in the use of myth, stream of consciousness, and symbolism. Authors studied may include Hardy, Conrad, Owen, Joyce, Lawrence, Woolf, Eliot, Yeats, and Orwell. This course will be offered in 2021-22, and in alternating years thereafter.

Department

English

Category

Category II (offered at least every other Year)

Units 1/3

EN 2244 : 19th-Century English Literature

Participants in this course will examine outstanding works of 19th-century English poetry and fiction, and consider questions of identity, beauty, judgment, and social responsibility. Writers covered may include such figures as Jane Austen, John Keats, Charles Dickens, and Robert Browning.
This course will be offered in 2022-23, and in alternating years thereafter.

Department
English
Category
Category II (offered at least every other Year)
Units 1/3

EN 2251 : Moral Issues in the Modern Novel

This course focuses on the problem of how to live in the modern world. Emphasis will be placed on the way moral issues evolve within the complications of individual lives, as depicted in fiction. Such authors as Conrad, Kesey, Camus and Ellison show characters struggling with the questions of moral responsibility raised by love, religion, death, money, conformity.

Department
English
Category
Category I (offered at least 1x per Year)
Units 1/3

EN 2252 : Science and Scientists in Modern Literature

This course surveys the ways in which modern literature has represented science and scientists. Beginning with Mary Shelley's Frankenstein, the origin of what Isaac Asimov calls the "damned Frankenstein complex" is examined. More complex presentations of science and scientists occur in twentieth-century works like Brecht's Galileo, Huxley's Brave New World, and Pirsig's Zen and the Art of Motorcycle Maintenance. The course covers major modern works of fiction and drama, including such literary forms as the play, the novel of ideas, and the utopian novel. Attention is focused on the themes (ideas) in, and the structure of, these works.

Department
English
Category
Category I (offered at least 1x per Year)
Units 1/3

EN 2271 : American Literary Histories

An investigation into one or more major movements or periods in American literature, focusing on aesthetic formations such as sentimentalism, realism, modernism, or postmodernism, on cultural formations from Transcendentalism and Regionalism through the Lost Generation and the Harlem Renaissance to the Beat Generation and the Native American Renaissance, or delivered through chronological engagements by century, by decade, or by other suitable framings attending to specific communities or sets of writers.

Department
English
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
None, though coursework in English (e.g. EN 1251, Introduction to Literature) or any subsequent EN offering will be helpful.

EN 2281 : World Literatures

This course will examine literary works from two or more languages, modes, and/or traditions, often connecting these works to other works of expressive culture in the visual and performing arts. Some iterations may turn on a broader survey, others on more particular engagements with wider inflections. Material introduced beyond English will rely on translations but may also include attention to work in the original language. Attention to drama, poetry, and prose from various periods and places will encourage students to connect themes across cultural, formal, and historical divides, utilizing interdisciplinary and theoretical methods in the process of their reading and writing. Students who have previously taken EN 230X cannot take this course for credit.

Department

English

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

None, though coursework in English (e.g. EN 1231, Introduction to Literature) or any subsequent EN offering will be helpful, as will courses emphasizing literature and culture offered in AB, CN, GN, and/or SP.

EN 2500/TH 2500 : Fundamentals of Technical Theatre

This course introduces students to a variety of technical theatre disciplines, including scenery, lighting, sound, props, and costumes. Students will explore each technical element through a combination of lectures, demonstrations, and workshops, and will demonstrate their learning through group projects and other hands-on activities.

Students may not receive credit for TH 2500 and either EN 2222 or TH 2222.

Department

Theatre

English

Category

Category I (offered at least 1x per Year)

Units 1/3

EN 3219 : Advanced Creative Writing

This advanced seminar in creative writing includes sustained attention to the writing of fiction, poetry, and short prose forms among other genres, culminating in final projects (essay, play, poem, story, or some combination thereof) determined by individual interest and in consultation with the instructor. Investigation will also focus on the reading and discussion of exemplary works across genres, with an emphasis on contemporary practice. In the process, regular writing exercises and class visits from established authors will help to create a community of writers grounded in diverse methods. This course will be offered in 2021-22, and in alternating years thereafter.

Department

English

Category

Category II (offered at least every other Year)

Units 1/3

Suggested

Introductory level creative writing (EN 2219 (formerly EN 3217) or equivalent).

EN 3226 : Strange and Strangers

This course examines the concept of “strange” and the figure of the “stranger” in a wide range of written and visual texts, from Shakespeare to Albert Camus to the 2017 horror/comedy film Get Out. We will focus on depictions of religious, racial, gendered, and other forms of alienation and otherness, from both an insider’s and outsider’s perspective. This course will be offered in 2022-23, and in alternating years thereafter.

Department

English

Category

Category II (offered at least every other Year)

Units 1/3

EN 3231 : Supernatural Literatures

Take a vacation from the rational, quantifiable, and verifiable, and dip your toes into the ineffable. Unbridled, boundary-bending, and binary-busting, supernatural literature makes space for lived (and undead) experiences outside the mainstream. This course will examine the following questions: How are supernatural stories culturally situated? How is language used in supernatural texts, and when and why does it break down? What can we can learn about the "real" through studying the fantastic? Course content will vary with each offering. Potential areas of focus might include magical realism, the supernatural and folklore, the gothic and gender, the gothic and race, the contemporary ghost story worldwide, and monstrosity and the grotesque. This course will be offered in 2022-23, and in alternating years thereafter.

Department

English

Category

Category II (offered at least every other Year)

Units 1/3

EN 3234 : Modern American Poetry

This course examines the poetries and poetics of various modern and contemporary American traditions, focusing on schools and styles from the Modernists and Objectivists through the Black Arts Movement, Confessional Poetry, the New York School, and the San Francisco Renaissance. Attention will also be given to recent innovations in digital poetry, multiethnic poetry, and performance poetry. The course will include poets such as Wallace Stevens, Gwendolyn Brooks, Elizabeth Bishop, A.R. Ammons, Joy Harjo, Jimmy Santiago Baca, Myung Mi Kim, and Saul Williams. This course will be offered in 2022-23, and in alternating years thereafter.

Department

English

Category

Category II (offered at least every other Year)

Units 1/3

EN 3238 : American Authors

EN faculty with expertise in American literature will select one or more authors to focus on in this course. Examples of such authors are James Baldwin, Octavia Butler, William Faulkner, Anne Sexton, and August Wilson. These authors often criticize the political and social status quo, addressing inequities in matters of class, gender, race, and sexuality. The intention is for students to focus on such authors in depth, in preparation for their final seminar or practicum. Faculty offering the course will indicate which authors they intend to present on the HUA website well before student signups, to permit efficient program planning.

This course will be offered in 2022-23, and in alternating years thereafter.

Department

English

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

None, though coursework in English (e.g. EN 1251, Introduction to Literature) or any subsequent EN offering will be helpful.

EN 3248 : The English Novel

Participants in this seminar will examine the English novel from its origins in the eighteenth century to its twentieth-century forms, exploring the rich variety of ways a writer may communicate a personal and social vision. The novels treat love, travel, humor, work, adventure, madness, and self-discovery; the novelists may include Fielding, Austen, Dickens, Eliot, Wodehouse, and Woolf.

Department

English

Category

Category I (offered at least 1x per Year)

Units 1/3

EN 3271 : American Literary Topics

This course investigates American literature as it relates to a specific theme, issue, controversy, or question. Attention might center upon topics from childhood and friendship to captivity and freedom, and from immigration and labor to law and war, drawing on or even focusing more decidedly upon aspects of identity including but not limited to class, ethnicity, gender, race, religion, and sexuality Authors might extend from nineteenth century exemplars including Emily Dickinson, Herman Melville, Henry David Thoreau, and Walt Whitman to twentieth and twenty-first century figures such as Philip K. Dick, Toni Morrison, Thomas Pynchon, Leslie Marmon Silko, and Richard Wright.

Department

English

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

None, though coursework in English (e.g. EN 1251, Introduction to Literature) or any subsequent EN offering will be helpful.

English for International Students

ISE 1800 : Introduction to Academic Reading and Writing for Non-Native Speakers of English

The goal of this course is to provide international students for whom English is not their native language the necessary skills for academic success through reading and writing assignments. Students will focus on developing vocabulary, critical reading, paragraph, and essay writing skills. Emphasis is also given to a review of English grammar through intensive written and oral practice to promote accurate and appropriate language use. Strongly recommended for first-year international non-native English speakers. Admission determined by Writing Placement or consent of the instructor.

Department

English for International Students

Units 1/3

ISE 1801 : Composition for Non-Native Speakers of English

This course is for international students who want to develop their academic writing skills through a sequence of essay assignments, with emphasis on rhetorical and grammatical issues particular to second language learners (ESL). Students will concentrate on producing coherent paragraphs, developing short essays in a variety of rhetorical modes, and improving mechanics (grammar and punctuation) and vocabulary usage. Both personal and academic writing assignments provide practice in the process of writing and revising work for content and form.

Department

English for International Students

Units 1/3

Recommended Background

ISE 1800 or equivalent skills (determined by Writing Placement or consent of the instructor).

ISE 1803 : Oral Communication for Non-Native Speakers of English

This course focuses on the speaking and listening skills that are necessary in an academic setting. Students practice formal and informal communication skills, including listening comprehension, pronunciation, and conversational and presentation skills. Students are encouraged to practice oral/aural exercises with the class as a whole and in small groups. Class work will build language skills and personal confidence levels.

Department

English for International Students

Units 1/3

ISE 2800 : College Writing for Non-Native Speakers of English

In this course students will practice analytical reading, writing, and thinking intensively, through a variety of exercises and assignments. Emphasis is placed on using various methods of organization appropriate to the writer's purpose and audience. Students will read and discuss a selection of non-fiction texts; these readings will form the basis for writing assignments in summary, critique, synthesis, and persuasion. The course also stresses the ability to understand, use, and document college-level non-fiction readings as evidence for effectively formulating and accurately supporting a thesis. This course is for international students who have already studied grammar extensively and need to refine the ability to produce acceptable academic English.

Department

English for International Students

Units 1/3

Recommended Background

ISE 1801 or equivalent skills (determined by Writing Placement or consent of the instructor).

ISE 2810 : Listening and Speaking for Non-native Speakers

This course addresses the academic needs of high-intermediate/advanced non-native English language learners by developing their listening and speaking skills. Students will engage in activities to practice and improve listening skills, and participate in speaking activities to improve comprehensibility through pronunciation improvement. Note: Students who have taken ISE 28IX may not receive credit for this course. This course will be offered in 2021-22, and in alternate years thereafter.

Department

English for International Students

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

Oral communication skills (ISE 1803) or equivalent skills.

ISE 2820 : Critical Reading of our World

The goal of this course is to provide non-native English language students the skills to work with the highest levels of academic and professional reading. Students will develop active and critical reading skills by annotating self-selected academic journal articles, research reports, current news reports and autobiographical literature. Students will create annotated bibliographies, summaries, literature reviews, and critical reaction papers. Students will learn to analyze, synthesize and cite multiple sources when doing academic work. Students will also increase their vocabulary of high-level academic and professional terms. Note: Students who have taken ISE 282X may not receive credit for this course. This course will be offered in 2021-22, and in alternate years thereafter.

Department

English for International Students

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

Composition for Non-native Speakers of English (as covered in ISE 1801) or equivalent skills.

ISE 3800 : Loaded Language: Discourse and Power in International English

This course, for international non-native English speakers, examines how the varieties of this global language can define identity, reflect social structures, and create and maintain power differentials. The course examines discourse, coded language and labels, accents, and strategies for communicating across cultures. We will explore the effects of World Englishes on our own minds, our classroom, our campus, our local community, and the global stage. This course satisfies the Inquiry Seminar requirement. Note: Students who have taken ISE 380X may not receive credit for this course. This course will be offered in 2021-2022, and in alternate years thereafter.

Department

English for International Students

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

Composition for non-native speakers of English (ISE 1801) or equivalent skills.

German

GN 1511 : Elementary German I: Identities and Communities

Intensive language course that explores topics such as self, family, and community in German-speaking contexts. The course addresses the questions “Who am I?” and “How does my immediate environment shape my identity?” By working alone and in small groups with level-appropriate texts in German such as short readings, music, images, and videos, students develop their interpretive, interpersonal and presentational competence at a survival level in meaningful everyday contexts.

Department
German
Category
Category I (offered at least 1x per Year)
Units 1/3

GN 1512 : Elementary German II: Navigating Everyday Life in German-speaking Contexts

Broadens the themes of Elementary German I from one’s immediate environment to aspects of everyday life related to work and leisure (e.g. food, shopping, living accommodations). Students develop their interpretive, interpersonal and presentational competence in meaningful contexts by working intensively with longer authentic texts in German such as websites, catalogs, short prose texts, music, images and videos. Through communicative tasks and presentations in small groups related to everyday life, students develop skills necessary to negotiate a variety of cultural settings in the German-speaking world.

Department
German
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
GN 1511 or equivalent

GN 2511 : Intermediate German I: Cultural Practices and Products of the German-Speaking World

Builds on the foundation of Elementary German by moving from the level of immediate everyday contexts towards broader cultural phenomena. Students investigate cultural practices, attitudes and products related to a variety of topics such as health and hygiene, environmental protection, travel and transportation, childhood, work, and education. Work with language supports interpretations of short texts (written, viewed, and heard), small-group interactions that navigate real-life situations, and presentations on key cultural products of the German-speaking world.

Department
German
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
GN 1512.

GN 2512 : Intermediate German II: Pasts, Presents, and Futures of the German-Speaking World

This course bridges the intermediate and advanced levels by preparing students to interpret longer texts (written, viewed, and heard) about the German-speaking world’s history, contemporary life, and visions for the future. In small groups, students navigate meaningful real-life situations in order to develop the advance-level skill of narration in all time frames (past, present and future), as well as the historical knowledge to contextualize the cultural products and practices of the German-speaking world.

Department
German
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
GN 2511 or equivalent

GN 3511 : Advanced German I: Exploration and Innovation in the German-Speaking World

The first course in the second-year sequence explores innovation in social, political, and scientific contexts in the German-speaking world. Students interpret increasingly sophisticated media (news segments, interviews, short literary texts, historic documents, songs, etc.), realize complex communicative tasks in meaningful contexts, and present on various cultural products and historical events. At the end of this course students will be able to use written and spoken German to narrate complex events in multiple time frames. Special emphasis on the development of written communication skills.

Department

German

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

GN 2512 (Intermediate German II).

GN 3512 : Advanced German II: National Identities and Stories

How are national identities communicated, contested, and settled? This course foregrounds the diversity of German culture as disseminated through various media. Students will interpret and present on longer texts (e.g. film, music, literature), and discuss these in the form of complex written and oral discourse. At the end of the course students will be able to communicate in German about topics and issues (e.g. history, citizenship, migration) central to cultural discourse in the German-speaking world. Special emphasis on the development of written communication. This course satisfies the Inquiry Practicum Requirement.

Department

German

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

GN 3511.

GN 3513 : Survey of German Civilization and Culture from 1871 to the Present

Conducted entirely in German, the course presents an overview of the development of modern Germany and its culture since the founding of the Second Empire. Background readings in German and English provide the basis for in-class discussion of selected authentic German texts of various kinds: literary works, official documents, political manifestos, letters, and diaries. At least one film will be shown. A number of recurring themes in German culture will inform the content of the course: authoritarianism versus liberalism, idealism versus practicality, private versus public life. This course satisfies the Inquiry Practicum requirement. This course will be offered in 2022-23, and in alternating years thereafter.

Department

German

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

GN 3511 (Advanced German I) and GN 3512 (Advanced German II) or equivalent.

GN 3514 : Seminar on Selected Topics in German Literature

The content of the seminar will change from time to time. The course will focus either on an author (e.g., Goethe, Heine, Kafka, Gunter Grass, Christa Wolf), a genre (e.g., lyric poetry, drama, narrative prose), a literary movement (e.g., Romanticism, expressionism), or a particular literary problem (e.g., literature and technology, writing and the Holocaust, writing and the city). The seminar will be conducted entirely in German. This course satisfies the Inquiry Practicum requirement. This course will be offered in 2021-22, and in alternating years thereafter.

Department

German

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

GN 3511 (Advanced German I) and GN 3512 (Advanced German II) or equivalent.

GN 3516 : German Film

Since its beginnings in the early 20th century, film has been a powerful medium for popular entertainment as well as a potent expression of society's dreams, fears, and values. Films made in the German-speaking countries are no exceptions, from early expressionist films like The Cabinet of Dr. Caligari through Nazi documentaries like Triumph of the Will to today's feature films such as Grizzly Man and Run Lola Run! Many German directors have achieved international renown. This course, conducted in German, will examine representative German-language films from various perspectives: historical, socio-political, and thematic. Films will be shown in German with English subtitles. The course will include weekly screenings, discussion sessions, and substantial written assignments. This course satisfies the Inquiry Practicum requirement. This course will be offered in 2022-23, and in alternating years thereafter. Some sections of this course may be offered as Writing Intensive (WI).

Department

German

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

GN3512 or higher.

History

HI 1311 : Introduction to American Urban History

An introduction to the history of the American city as an important phenomenon in itself and as a reflection of national history. The course will take an interdisciplinary approach to study the political, economic, social, and technological patterns that have shaped the growth of urbanization. In addition to reading historical approaches to the study of American urban history, students may also examine appropriate works by sociologists, economists, political scientists and city planners who provide historical perspective.

Department

History

Category

Category I (offered at least 1x per Year)

Units 1/3

HI 1313 : The US and the World

In this introductory course, we will trace the history of the United States and the world from the late nineteenth century to the present. A global approach to U.S. history offers new perspectives on international relations, war, migration, labor, race, gender, and democracy. By exploring case studies from around the world, we will also practice crucial historical skills: asking questions about change overtime, finding evidence about the contexts of decision-making, and presenting arguments in an engaging form.This course is excellent preparation for any of WPI's international project centers.

Department

History

Category

Category I (offered at least 1x per Year)

Units 1/3

HI 1314 : Introduction to Early American History

An introduction to historical analysis through selected periods or themes in the history of America before the Civil War. A variety of readings will reflect the various ways that historians have attempted to understand the development of America.

Department

History

Category

Category I (offered at least 1x per Year)

Units 1/3

HI 1322 : Introduction to European History

This course introduces students to the major currents that have defined modern European History. Themes and topics will vary and may include the philosophical impact of science on modern thought, the development of liberalism and socialism, the crisis of culture in the twentieth century. Students read selections on major episodes in European history and develop their skills in critical thinking, analysis, oral and written argument. No prior knowledge of European history is required. Some sections of this course may be offered as Writing Intensive (WI).

Department

History

Category

Category I (offered at least 1x per Year)

Units 1/3

HI 1330 : Introduction to the History of Science and Technology

An introduction to the questions, methods and source materials that shape historical studies of science and technology. Sections vary in content and emphases; some may explore the interplay of science and technology across time, while other sections might exclusively develop themes within either the history of science or the history of technology. Students can receive credit only once for HI 1330, 1331, or 1332.

Department

History

Category

Category I (offered at least 1x per Year)

Units 1/3

HI 1345 : Atlantic Worlds

This introductory course reviews the history and legacies of Atlantic systems such a colonialism and migration that have connected Africa, the Americas, and Europe from the sixteenth century to the recent past. Taking a transregional approach to historical inquiry, the course places the Atlantic Ocean at its geographic center and explores the diverse people, cultures, ideologies, institutions, economies, and other phenomena that have traversed this ocean basin and connected the regions that line its shores. The course pays special attention to the technological, social, and political innovations, the systemic inequalities, and the heterogeneous notions of belonging that have emerged from transatlantic interactions and exchanges. The course can provide students with preparation for HUA depth in Global History and International and Global Studies as well as work at overseas project centers in regions often incorporated into Atlantic Worlds. No prior background is required.

Department

History

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

None.

HI 1350 : Introduction to Environmental History

An introduction to the questions, methods, and source materials that shape historical studies of the environment. This course will explore the influence of nature (i.e., climate, topography, plants, animals, and microorganisms) on human history and the reciprocal influence of people on nature.

Department

History

Category

Category I (offered at least 1x per Year)

Units 1/3

HI 2310 : Topics in Urban History

This course surveys the interplay of social, economic, demographic, political and cultural forces in shaping the growth, decline and occasional rebirth of urban spaces. Emphasis is placed upon building chronological narratives while attending to the themes, approaches, and sources historians use to reconstruct the tangled infrastructures, stratified economies, segregated spaces and political/ administrative structures of cities. Geographies will vary across sections and topics may include Industrializing Cities, Race and Urban Space, Post-Industrial Cities, Urban Technological Infrastructures, or Social Justice in the City. Students can receive credit only once for HI 2310.

Department

History

Category

Category I (offered at least 1x per Year)

Units 1/3

HI 2311 : American Colonial History

This course surveys early American history up to the ratification of the Constitution. It considers the tragic interactions among Europeans, Indians, and Africans on the North American continent, the growth and development of English colonies, and the revolt against the Empire that culminated in the creation of the United States of America.

Department

History

Category

Category I (offered at least 1x per Year)

Units 1/3

HI 2313 : American History, 1789-1877

This course surveys American history from the Presidency of George Washington to the Civil War and its aftermath. Topics include the rise of American democracy, the emergence of middle-class culture, and the forces that pulled apart the Union and struggled to put it back together.

Department

History

Category

Category I (offered at least 1x per Year)

Units 1/3

HI 2314 : American History, 1877-1920

This course surveys the transformation of the United States into an urban and industrial nation. Topics will include changes in the organization of business and labor, immigration and the development of cities, the peripheral role of the South and West in the industrial economy, politics and government in the age of "laissez-faire," and the diverse sources and nature of late 19th- and early 20th-century reform movements.

Department

History

Category

Category I (offered at least 1x per Year)

Units 1/3

HI 2315 : The Shaping of Post-1920 America

This course surveys the major political, social, and economic changes of American history from 1920 to the present. Emphasis will be placed on the Great Depression, the New Deal, suburbanization, McCarthyism, the persistence of poverty, the domestic effects of the Vietnam war, and recent demographic trends.

Department

History

Category

Category I (offered at least 1x per Year)

Units 1/3

HI 2316 : Twentieth Century American Foreign Relations

This survey of American diplomatic history begins with World War I and World War II, continues through the early and later Cold War periods, including the Vietnam War, and concludes with an overview of 9/11 and wars in Iraq and Afghanistan. It includes traditional political and diplomatic history, but also broader conceptions of American foreign relations such as culture, economic development, and environment. It addresses the question of American empire, and stresses understanding U.S. policy and actions through a broad international perspective. This course is excellent preparation for any of WPI's overseas project centers. Some sections of this course may be offered as Writing Intensive (WI). This course will be offered in 2022-23 and in alternating years thereafter.

Department
History
Category
Category II (offered at least every other Year)
Units 1/3

HI 2318 : Topics in Law, Justice and American Society

This course treats law as a powerful social, economic and political phenomenon that cannot be fully understood apart from its history. Through a focus upon a particular theme and chronology, each section surveys the role of law (constitutional, statutory, regulatory and common) and legal institutions in shaping American society and culture, as well as how the law and its institutions have been shaped by individuals, advocacy groups, and broader social, cultural and political forces. Different sections of this course might explore constitutional law and social change (e.g. civil rights, abortion, and same sex marriage); criminal law and mass incarceration; law and the construction of race; law and gender; or patents, copyrights and intellectual property. This course may be repeated for different topics, and students who took HI 2317 may take HI 2318.

Department
History
Category
Category I (offered at least 1x per Year)
Units 1/3

HI 2320 : Modern European History

A survey of the major developments in European history from the nineteenth century to the present. The course will focus upon those factors and events that led to the formation of modern European society: revolutions, nationalism, industrialization, world wars, the Cold War, the creation of the European Union. No prior knowledge of European history is required. Especially appropriate for students interested in WPI's global Project Centers in Europe. Students may not receive credit for HI 2320 and HI 2322.

Department
History
Category
Category I (offered at least 1x per Year)
Units 1/3

HI 2328 : History of Revolutions in the Twentieth Century

A survey of some of the most important revolutionary movements of the twentieth century. We may consider topics such as racial, nationalist, feminist and non-violent revolutionary ideologies, communist revolution, the "green" revolution and cultural revolution. No prior knowledge of the history of revolutions is expected. This course will be offered in 2021-22, and in alternating years thereafter.

Department
History
Category
Category II (offered at least every other Year)
Units 1/3

HI 2329 : European Empires

This course takes a thematic approach to the history of European empires. Units focus upon important events and moments in European imperialism and decolonization from the perspective of both the colonizers and colonized. Specific topics may include slavery and emancipation, imperial racism, the civilizing mission, religious motivations, violence, gender and empire, disease and poverty, environmental degradation, empires at war, and postcolonial legacies. Especially appropriate for students interested in projects centers located in Europe or formerly colonized areas. No prior knowledge required.
Students may not receive credit for both HI 2324 and HI 2329.

Department
History
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
None.

HI 2335 : Topics in the History of American Science and Technology

This course surveys the interplay of science, technology and culture in American national development. Emphasis is placed upon building chronological narratives while attending to the themes, approaches, and sources historians use to explore Americans' enthusiastic but sometimes controversial embrace of science and technology. Chronologies and themes will vary across sections covering topics such as Science, Technology and Culture in Early America; Science, Technology in Industrializing America; Science and Technology in Post-1945 America; and Technology and Culture in the Rise of Urban America. This course may be repeated for different topics. No prior coursework or background in the history of science and technology is required.
Department
History
Category
Category I (offered at least 1x per Year)
Units 1/3

HI 2341 : Contemporaryworld Issues in Historical Perspective

This course examines the historical origins of contemporary global crises and political transformations. Students keep abreast of ongoing current events through periodical literature and explore the underlying long-term causes of these events as analyzed by scholarly historical texts. Topics will vary each time the course is taught but may include such topics as the following: The Israeli-Palestinian Conflict, Democratization in Africa, the Developing World and Globalization. No prior knowledge of world history is required. This course will be offered in 2021-22, and in alternating years thereafter.
Department
History
Category
Category II (offered at least every other Year)
Units 1/3

HI 2343 : East Asia: China at the Center

This course will explore two thousand years of Asian participation in an international system, in Asia and with the rest of the world. Whether ruled by Chinese, Turks, Mongols or Manchus, China has been the political and cultural center of East Asia. Understanding the role of this superpower is critical to Asian and world history. The course will focus on themes such as the cosmopolitan experience, the early development and application of 'modern' ideas such as bureaucracy, market economy, and paper currency, and the centrality of religious ideology as a tool in statecraft. No prior knowledge of Asian history is required. This course will be offered in 2022-23, and in alternating years thereafter.
Department
History
Category
Category II (offered at least every other Year)
Units 1/3

HI 2345 : Welcome to Paradise: the U.S. and the Caribbean

The Caribbean has been globally imagined and described as an everlasting Garden of Eden where the land, bodies, and cultures of its inhabitants are open to be consumed in various ways and where visitors can satisfy all their desires. In addition, hurricanes and other natural disasters have made headlines around the world, casting the region as a space of inevitable doom. But there is more to the story. In fact, the relationship between the U.S. and the Caribbean reveals an even more complex narrative characterized by imperialism, racism, migrations, and geopolitical strife. Through case studies, this course will interrogate the impact of U.S. imperialist stance in the Caribbean, as well as Caribbean peoples' responses to that stance. By mapping out the many ways in which the histories of the U.S. and the Caribbean intersect, we will shape our own understanding of this relationship and assess its significance today.

Department

History

Category

Category I (offered at least 1x per Year)

Units 1/3

HI 2350 : Topics in the History of Science

This course surveys the major developments, research enterprise, controversies and cultural contexts of particular scientific fields while also engaging students in examining the questions, methods and sources that inform the history of science. Sections will vary in topic, focusing on the history of a subset selected from among the following fields: astronomy, cosmology, mathematics, biology, medicine, ecology, evolutionary ideas, the earth sciences, chemistry, physics, or the human sciences. This course may be repeated for different topics. No prior coursework or background in the history of science is required.

Department

History

Category

Category I (offered at least 1x per Year)

Units 1/3

HI 2351 : History of Ecology

Department

History

Units 1/3

HI 2400 : Topics in Environmental History

This course surveys the methods and sources that historians adopt to answer three questions central to environmental history: How have constantly changing natural environments shaped the patterns of human life in different regions? How have different human cultures perceived and attached meanings to the natural and built worlds around them, and how have those attitudes shaped their social, economic political, and cultural lives? Finally, how have people altered the world around them, and what have been the consequences of change for natural and human communities alike? Sections will vary in content and emphases alternating between North American, regional, or global approaches. This course may be repeated for different topics. No prior coursework or background in environmental history is required.

Department

History

Category

Category I (offered at least 1x per Year)

Units 1/3

HI 2401 : U.S. Environmental History

Department

History

Units 1/3

HI 2403 : Global Environmental History

Department

History

Units 1/3

HI 2900 : Topics in Gender and History

This seminar course examines topics related to gender and history. It seeks to examine gender-related theories and analytical concepts in the context of the historical periods and social movements from which contemporary ideas about gender emerge. Specific themes and topics will vary by section and instructor, and may include: gender and war, cultural history of gender, gender and intersectionality, gender and colonialism/decolonization, issues of sexuality, women's history, and issues of masculinity, among others. No prior background is required. This course may be repeated for different topics. This course will be offered in 2021-22 and in alternating years thereafter.

Department

History

Category

Category II (offered at least every other Year)

Units 1/3

HI 2913 : Capitalism and Its Discontents

This course focuses on modern capitalism as an economic, social, and cultural formation in global perspective. As capitalism has radically changed the way humans live and work, critics have articulated their various discontents. Topics to be discussed include colonialism, enslavement, industrialization, social movements, automation, climate change, and global inequality. In addition to our readings, students will directly engage with the rich materials on global labor history available at WPI and in Worcester. This course will be offered in 2021-22, and in alternating years thereafter.

Department

History

Category

Category II (offered at least every other Year)

Units 1/3

HI 2921 : Topics in Modern European History

This seminar course examines topics in the cultural, socio-economic and political history of modern Europe. Topics may vary each year among the following: sport and society, film and history, nationalism, gender and class, political economy, environmental history Readings will include primary and secondary sources. No prior background is required. Students may not receive credit for both HI 3321 and HI 2921. This course will be offered in 2021-22 and in alternating years thereafter.

Department

History

Category

Category II (offered at least every other Year)

Units 1/3

HI 2930 : Topics in Latin American History

This seminar course examines topics in the history of Latin America. It bases those topics on issues in the region that are of critical importance in the present, and it outlines the historical origins and interrogates the historical contexts of those issues. Topics and course materials may vary each year depending on the issues addressed. The broad themes with which these topics may engage include: science, technology, and development; energy, sustainability, and the environment; inequality and social justice; migration and mobility; U.S.-Latin American relations; democracy, populism and nationalism; the Cold War and the post-Cold War global order. Readings will include primary and secondary sources. No prior background is required. This course will be offered in 2021-22 and in alternating years thereafter.

Department

History

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

None.

HI 3312 : Topics in American Social History

A seminar course on analysis of selected aspects of social organization in American history, with emphasis on the composition and changing societal character of various groups over time, and their relationship to larger social, economic, and political developments. Typical topics include: communities, families, minorities, and women.

Department

History

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

Some college-level American history.

HI 3314 : The American Revolution

This seminar course considers the social, political, and intellectual history of the years surrounding American independence, paying particular attention to the changes in society and ideas that shaped the revolt against Great Britain, the winning of independence, and the creation of new political structures that led to the Constitution.

Department

History

Category

Category I (offered at least 1x per Year)

Units 1/3

HI 3316 : Topics in Twentieth-Century U.S. History

In this advanced seminar course, students will explore one aspect of twentieth-century U.S. history in more depth. Topics vary each year but may include political movements such as the New Deal or the Civil Rights Movement, an aspect of American foreign policy such as the Cold War, a short time period such as the 1960s, a cultural phenomenon such as consumption, or a geographical focus such as cities or New England. The course will require substantial reading and writing. This course will be offered in 2021-22, and in alternating years thereafter.

Department

History

Category

Category II (offered at least every other Year)

Units 1/3

Suggested

HI 2314 (American History, 1877-1920), HI 2313 (The Shaping of Post-1920 America), or other American history courses.

HI 3317 : Topics in Environmental History

In this seminar course, students will explore one aspect of U.S. or global environmental history in more depth. Topics vary each year but may include environmental thought, environmental reform movements, comparative environmental movements, natural disasters, the history of ecology, built environments, environmental justice, New England environmental history, or the environmental history of South Asia or another region of the world. The course will require substantial reading and writing. This course will be offered in 2022-23, and in alternating years thereafter.

Department

History

Category

Category II (offered at least every other Year)

Units 1/3

Suggested

HI 2401 U.S. Environmental History.

HI 3331 : Topics in the History of European Science and Technology

A seminar course on the relationships among science, technology, and society in European culture, examined through a series of case studies. Topics from which the case studies might be drawn include: global scientific expeditions, mapmaking, and European imperialism; the harnessing of science for industrial purposes; the role of the physical sciences in war and international relations; the function of the science advisor in government; the political views and activities of major scientists such as Einstein. Students will use primary sources and recently published historical scholarship to analyze the case studies. This course will be offered in 2022-23, and in alternating years thereafter.

Department

History

Category

Category II (offered at least every other Year)

Units 1/3

Suggested

Courses in European history and the history of science and technology.

HI 3333 : Topics in American Technological Development

Department

History

Units 1/3

HI 3334 : Topics in the History of American Science and Technology

This seminar will examine a particular issue or theme in the history of American science and technology. Topics will vary from year to year, but may include: technology and the built environment; science, technology and the arts; communications of science and scientific issues with the larger public; technology and scientific illustration; science in popular culture; science and the law; or close examination of episodes in the history of American science and technology such as the American Industrial Revolution; science and technology in the years between the world wars; the Manhattan Project; science and the culture of the Cold War; or science, technology and war in American history. This course will require significant reading and writing.

Department

History

Category

Category I (offered at least 1x per Year)

Units 1/3

Suggested

Some familiarity with history of science or history of technology, and with United States history.

HI 3335 : Topics in the History of Non-Western Science and Technology

A seminar course on the relationships among science, technology, and society from cultures outside Europe and North America, examined through a series of case studies. Topics from which the case studies might be drawn include: Chinese medicine and technology; Arabic mathematics, medicine, and astronomy; Indian science and technology (including, for example, metalworking and textile production); Mayan mathematics and astronomy; Polynesian navigation; various indigenous peoples' sustainable subsistence technologies (e.g. African agriculture, Native American land management, aboriginal Australian dreamtime). This course will be offered in 2021-22, and in alternating years thereafter.

Department

History

Category

Category II (offered at least every other Year)

Units 1/3

Suggested

Courses in global history and the history of science and technology.

HI 3341 : Topics in Imperial and Postcolonial History

This seminar course examines topics in the history of European imperialism, colonialism, and the postcolonial aftermath. Topics vary each year among the following: culture and imperialism, the expansion of Europe, the economics of empire, travel and exploration narratives, imperialism in literature and anthropology, decolonization in Asia and Africa, postcolonial studies. Readings will include primary and secondary sources. This course will be offered in 2022-23, and in alternating years thereafter.

Department

History

Category

Category II (offered at least every other Year)

Units 1/3

HI 3343 : Topics in Asian History

This seminar course examines topics in the cultural, socio-economic, religious and political history of East Asia. Topics vary each year and may include the following: nationalism and the writing of history, travel and exploration narratives, cross-cultural contact, the role of religion and ideology in political history, development and the environment in Asia, film and history, and the place of minorities and women in Asian societies. Suggested background: previous courses on Asia such as HU 1412, HI 2328, HI 2343, or RE 2724. Some sections of this course may be offered as Writing Intensive (WI).

Department

History

Category

Category I (offered at least 1x per Year)

Units 1/3

HI 3344 : Pacific Worlds

The Pacific Ocean covers a third of our earth's surface. Home to over a thousand languages and thousands of years of rich histories, the Pacific has been and continues to be one of the most diverse regions of cultural, social, economic, and environmental interaction. The course focuses on both local connections to the Pacific, such as the New England whaling industry, and global issues, such as the impact of climate change on Pacific islanders. Other topics to be discussed include the environment, oceanic navigation, arts, colonialism, race, and migration. This course will be offered in 2022-23, and in alternating years thereafter.

Department

History

Category

Category II (offered at least every other Year)

Units 1/3

Music

MU 1511 : Introduction to Music

This course, designed for students who have little or no previous experience in music, will present an approach to the study of music that includes studying some concepts of music theory (rhythms, scales, keys, intervals, harmony). The course will also include a study of some of the great masterpieces though listening, reading, and discussion.

Department

Music

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

No previous experience is necessary.

MU 1611 : Fundamentals of Music I

This course concentrates on basic music theory of the common practice period. If time permits, instruction includes ear training, sight singing, and work on scales and intervals.

Department

Music

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

basic knowledge of reading music.

MU 2300 : Foundations of Music Technology

This course will present ways to facilitate musicianship through the use of technology. Course topics include an introduction to music notation software, MIDI and audio recording, signal processing, and interactive music system programming. The course will address past, current, and emerging trends in music technology as they relate to facilitating an understanding of musical concepts. Students may not receive credit for both MU 2300 and MU 230X. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Music

Category

Category II (offered at least every other Year)

Units 1/3

Suggested

a basic understanding of music notation and the fundamentals of music.

MU 2501/PSY 2501 : Music and Mind

How are we able to distinguish instruments, timbres and rhythms from the intertwined sonic stream presented by the world? How do we organize these elements in time to create rhythms, melodies, phrases and pieces? How do perception and memory interact to allow us navigate a musical work? We will explore these questions by considering the cognitive and perceptual processes that shape our musical experience. Topics will include event distinction, temporal perception, hierarchical organization, perceptual grouping, expertise, memory and categorization. We will illustrate these ideas in musical contexts by listening to a variety of musical works. We will consider how psychological principles are applied to music technologies, such as compression algorithms, mixing methodologies and the field of music information retrieval. We will consider experiments that focus on some of these topics to further our understanding about how we experience music. Note: Students that received credit for MU 202X may not receive credit for MU 2501. Students also may not receive credit for both MU 2501 and PSY 2501. This course can count for either the HUA or the SSPS requirement, but it cannot double count for both the HUA and SSPS graduation requirements.

Department

Music

Psychology

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Fundamentals of Music I and/or Fundamentals of Music II

MU 2611 : Fundamentals of Music II

Fundamentals II is a course on music theory at the advanced level beginning with secondary dominants and modulations and working through 19th-century chromatic harmony.

Department

Music

Category

Category I (offered at least 1x per Year)

Units 1/3

MU 2631 : Glee Club

The Glee Club is one of WPI's choral ensembles and the oldest student organization on campus. Glee Club performs many styles and periods of the vast repertoire of music featuring tenor and bass voices. Several times each year the Glee Club and Alden Voices (soprano and alto voices) join forces as the WPI Festival Chorus to perform major works of the repertoire. The Glee Club regularly performs on campus, throughout the Worcester area, and takes international and domestic tours. Rehearsals are held weekly. No audition is required. The course is open to all who are interested and sing in the tenor and bass range.

Department

Music

Category

Category I (offered at least 1x per Year)

Units 1/3

MU 2632 : Alden Voices

Alden Voices is one of WPI's choral ensembles and also functions as a student organization on campus. Alden Voices performs many styles and periods of the vast repertoire of music featuring soprano and alto voices. Several times each year the Alden Voices and the Glee Club (tenor and bass voices) join forces as the WPI Festival Chorus to perform major works of the repertoire. Alden Voices regularly performs on campus, throughout the Worcester area, and takes international and domestic tours. Rehearsals are held weekly. No audition is required. The course is open to all who are interested and sing in the soprano and alto range.

Department

Music

Category

Category I (offered at least 1x per Year)

Units 1/3

MU 2633 : Brass Ensemble

The Brass Ensemble performs frequently on campus and on tour and is open to students who perform on trumpet, trombone, euphonium, French horn, tuba, or tympani. Renaissance antiphonal music is included in the repertoire. Rehearsals are held weekly. Students are expected to perform with the ensemble and to know how to read music. Permission of the instructor is necessary to register.

Department

Music

Category

Category I (offered at least 1x per Year)

Units 1/3

MU 2636 : Concert Band

The Concert Band is a large ensemble that performs several concerts a year as well as on tour. Membership is open to those who play traditional wind, brass or percussion instruments. Rehearsals are held weekly. Students are expected to perform with the ensemble and to know how to read music.

Department

Music

Category

Category I (offered at least 1x per Year)

Units 1/3

MU 2637 : Orchestra

The Orchestra performs music for both a string ensemble and full orchestra on campus and on tour. Rehearsals are held weekly. Students are expected to perform with the ensemble and to know how to read music.

Department

Music

Category

Category I (offered at least 1x per Year)

Units 1/3

MU 2638 : Chamber Choir

The Chamber Choir is WPI's smaller, audition-based, choral ensemble. This ensemble explores specific stylistic techniques as pertains to the music of the Renaissance, Baroque, twentieth century, jazz, and extended vocal techniques (electronic, digital and experimental). The ensemble meets weekly. Students are expected to be of the highest vocal caliber and should possess advanced sight-reading techniques. Open to all who are interested. Permission of the instructor is necessary to register.

Department
Music
Category
Category I (offered at least 1x per Year)
Units 1/3

MU 2639 : String Quartet

The String Quartet is an audition-based, select ensemble. Members are required to also participate in Orchestra. The quartet meets weekly and performs both on campus and on tour. Students are expected to be of the highest caliber of string players and know how to read music. Permission of the instructor is necessary to register.

Department
Music
Category
Category I (offered at least 1x per Year)
Units 1/3

MU 2640 : African Drumming Ensemble

The African Drumming Ensemble meets weekly and performs both on campus and at community venues. Students of all experience levels are welcome to join. Auditions are not required for this ensemble, nor is the ability to read music. Traditional West African percussion styles are the primary focus of the ensemble, but other styles of music are also part of the ensemble's repertory.

Department
Music
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
None

MU 2641 : Percussion Ensemble

The Percussion Ensemble is an audition-based, select ensemble. The Percussion Ensemble performs a wide stylistic range of music from opera overtures to twentieth century minimalist compositions, to Caribbean songs. The ensemble meets weekly and performs on campus during the school year. Students must know how to read music. Permission of the instructor is necessary to register.

Department
Music
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
None

MU 2642 : Jazz Combo

The Jazz Combo is a small ensemble that performs frequently on campus and on tour, playing jazz arrangements written for a small ensemble with major emphasis on improvisation. Rehearsals are held weekly. Students are expected to perform with the ensemble, know how to read music, and have experience with improvisation. This is an auditioned group. Permission of the instructor is necessary to register.

Department

Music

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

None

MU 2643 : Jazz Ensemble

The Jazz Ensemble is an intermediate level ensemble that performs traditional and contemporary big band literature with an emphasis on stylistically appropriate interpretation and performance practice. The ensemble performs frequently on campus and on tour. Rehearsals are held weekly. Students are expected to perform with the ensemble and to know how to read music. This is an auditioned group. Permission of the instructor is necessary to register.

Department

Music

Category

Category I (offered at least 1x per Year)

Units 1/3

MU 2644 : Stage Band

The Stage Band is an advanced level ensemble that performs traditional and contemporary big band literature with an emphasis on stylistically appropriate interpretation and performance practice. The ensemble performs frequently on campus and on tour. Rehearsals are held weekly. Students are expected to perform with the ensemble and to know how to read music. This is an auditioned group. Permission of the instructor is necessary to register.

Department

Music

Category

Category I (offered at least 1x per Year)

Units 1/3

MU 2719 : Jazz History

Through an introduction to the musical contributions of Louis Armstrong, Duke Ellington, Charlie Parker, Miles Davis and others, students are exposed to the chronological development of the language of jazz. Each jazz era is examined in detail including the musical and social contexts which helped define it. Participants are expected to build aural skills with the goal of identifying specific historical periods through the recognition of particular musical characteristics. Students examine in depth one artist of their choice. This course will be offered in 2022-23, and in alternating years thereafter. [This replaces MU 4623. Credit is not allowed for both MU 4623 and MU 2719.]

Department

Music

Category

Category II (offered at least every other Year)

Units 1/3

MU 2720 : Music History I: Medieval Through the Baroque

This course provides a historical survey of Western music from Medieval through Baroque periods with an emphasis on understanding stylistic traits and theoretical concepts of the eras. Topics include Gregorian chant and secular monophony; evolution of musical notation; development of polyphonic music; and vocal and instrumental genres such as mass, motet, madrigal, opera, cantata, sonata, and concerto, among others. No prior background in music is necessary. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Music

Category

Category II (offered at least every other Year)

Units 1/3

MU 2721 : Music History II: Classical to the Present

This course provides a historical survey of Western music from the Classical period to the present with an emphasis on understanding stylistic traits and theoretical concepts of the eras. Topics include the development of genres such as sonata, string quartet, concerto, symphony, symphonic poem, character piece, Lied, and opera; and 20th century trends of impressionism, primitivism, atonality, serialism, minimalism, aleatory music, and electronic music. No prior background in music is necessary.

Department

Music

Category

Category I (offered at least 1x per Year)

Units 1/3

MU 2722 : History of American Popular Music

This course will explore the uniqueness of Americas popular music and its origins in the music of Africa and the folk music of Europe. Particular emphasis will be given to the origins and history of rock 'n roll examining its roots in blues and early American popular music. [This replaces MU 4625. Credit is not allowed for both MU 4625 and MU 2722.]

Department

Music

Category

Category I (offered at least 1x per Year)

Units 1/3

MU 2723 : Music Composition

This course will investigate the sonic organization of musical works and performances, focusing on fundamental questions involved in the process of composition: How do I connect different ideas? How can I make a larger work out of smaller parts? How can I vary statements to create interest without compromising coherence? Where do I start? A progressive series of composition projects will build techniques in relevant areas including rhythm, harmony, melody, and form. Exercises in mechanics will be complemented by contemplation and discussion of artistic, aesthetic and philosophical ideas that are equally important in the compositional process. We will examine the relationship between musical works and how they are communicated as instructions to others (e.g. orally, as symbols, prose, graphic images, or computer programs). Weekly listening, reading, and composition assignments draw on a broad range of musical styles and intellectual traditions from various cultures and historical periods.

Department

Music

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

understanding of basic music theory through coursework (e.g. MU 1511, Introduction to Music or MU 1611, Fundamentals of Music) or equivalent experience.

MU 2801 : Making Music with Machines

This course will explore automatic mechanical (electro)acoustic instruments, the people that design and build them and the music that they make. The subject is inherently interdisciplinary, so activities will engage with historical, musical, and technical matters. The history of automatic mechanical instruments reaches back centuries: we will study past designs so that we can better contextualize modern efforts, which have progressed alongside increasing computational power and machine sensing abilities. We will consider the music that has been composed using such instruments including the works of Anthiel, Nancarrow, Ligeti, Gann, and Metheny. In doing so, we will develop analytical tools required to understand such music and will illuminate relationships between electromechanical capabilities and musical ideas. The technical components of this course will introduce students to principles involved in instrument design, actuators, electronic circuits, microcontrollers, and musical programming environments. We will do all of this with our mind open to the question of how we can design new machines to make new kinds of music. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Music

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

Fundamentals of Music I and / or Fundamentals of Music II, experience with programming and electronic circuits is helpful.

MU 3001 : World Music

This course introduces students to selected musical cultures of the world, e.g., Africa, Asia, the Middle East, and Latin America, from the ethnomusicological perspective by examining their musical styles as well as cultural and social contexts. Students will be expected to read materials in interdisciplinary areas, including musical ethnographies. No prior background in music is necessary. This course will be offered in 2021-22, and in alternating years thereafter.

Department

Music

Category

Category II (offered at least every other Year)

Units 1/3

MU 3002 : Arranging and Orchestration

Students will study specific characteristics of instruments and the voice to enable them to successfully arrange vocal and instrumental music. Students will need to possess a basic knowledge of music theory. Suggested background for this course is MU 1611 (Fundamentals of Music I) or its equivalent.

Department

Music

Category

Category I (offered at least 1x per Year)

Units 1/3

MU 3510 : Music in Time of Conflict

This course will use music as a device to examine issues such as war, racial discrimination, refugee / homelessness, rehabilitation, and personal suffering. Works to be examined may include: Benjamin Britten's War Requiem and Ralph Vaughan Williams' Dona Nobis Pacem – critique and reactions to the World Wars; James MacMillan's Cantos Sagrados – a work highlighting the tragedies of political repression in Latin America; and Joel Thompson's Seven Last Words of the Unarmed – a piece of social justice that humanizes the black men who were unarmed, yet killed by authority figures. Along with the music, there may also be discussion of individual artists who have been outspoken about social issues, such as Leonard Bernstein in the 1960s, Dimitri Shostakovich under Stalin's rule, and contemporary pop and jazz artists.
This course will be offered in 2021-22, and in alternating years thereafter.

Department
Music
Category
Category II (offered at least every other Year)
Units 1/3
Recommended Background
Basic knowledge of reading music, such as personal experience, participation in ensembles, or music courses (MU 1611: Fundamentals of Music I, or MU 1511: Introduction to Music).

MU 3614 : Topics in Midi

This course examines topics in Music Technology in which the application of MIDI and MIDI systems play a significant role. Topics may vary each year among the following areas: sequencing, live performance, composition, and film scoring. Students can take MU 3614 only one time for credit, but a student interested in taking another version can take a second one as an ISU. This course will be offered in 2022-23, and in alternating years thereafter.

Department
Music
Category
Category II (offered at least every other Year)
Units 1/3
Recommended Background
MU 1611 (Fundamentals of Music)

MU 3615 : Topics in Digital Sound

This course examines topics in Music Technology in which Digital Sound plays a significant role. Topics may vary each year among the following areas: digital editing, audio recording, film scoring, game audio, sound effects, audio production, theatrical sound, and surround sound. Students can take MU 3615 only one time for credit, but a student interested in taking another version can take a second one as an ISU. This course will be offered in 2022-23, and in alternating years thereafter.

Department
Music
Category
Category II (offered at least every other Year)
Units 1/3
Recommended Background
MU 1611 (Fundamentals of Music)

MU 3616 : Topics in Interactive Programming

This course examines topics in Music Technology in which Interactive Programming plays a significant role. Topics may vary each year among the following areas: real time performance controllers, algorithmic composition, interface design, sensor technology, and gesture detection. Students can take MU 3616 only one time for credit, but a student interested in taking another version can take a second one as an ISU. This course will be offered in 2022-23, and in alternating years thereafter.

Department
Music
Category
Category II (offered at least every other Year)
Units 1/3
Recommended Background
MU 1611 (Fundamentals of Music)

MU 3620 : Electronic Music Composition

This course will address concepts of composition through the use of technology. Students will examine existing compositions in electronic music, art music, popular music, film, multimedia, games, and more, and compose new works within these genres. Students will present newly composed works each class and discuss their aesthetic values, musical functions, and technical underpinnings. Students may not receive credit for both MU 3620 and MU 362X. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Music

Category

Category II (offered at least every other Year)

Units 1/3

Suggested

knowledge of basic musicianship skills such as melody, harmony, and rhythm, as well as familiarity with at least one digital audio workstation or notation software.

MU 3730 : Jazz Theory

This course examines harmonic and melodic relationships as applied to jazz and popular music composition. Students are introduced to a wide range of jazz improvisational performance practices. Topics include compositional forms, harmonic structures, major and minor keys, blues, modal jazz, and re-harmonization techniques. Students are expected to have a basic knowledge of reading music. [This replaces MU 4624. Credit is not allowed for both MU 4624 and MU 2730.]

Department

Music

Category

Category I (offered at least 1x per Year)

Units 1/3

MU 4621 : Independent Instruction (Lessons) in Music

Students electing to complete their Humanities and Arts Requirement in music may, for one of their five courses, undertake 1/3 unit (normally at 1/12 unit per term) of private vocal or instrumental instruction. (Supplemental ensemble work is also strongly recommended.) The student must receive prior approval by a member of the WPI music faculty, and the instruction must be beyond the elementary level. Lessons involve a separate fee. Note that the maximum of 1/3 unit credit for lessons may be earned in addition to 1/3 unit credit for performance (see condition A or B below). Additional work, either in performance or lessons, may be acknowledged on the WPI transcript but will carry no WPI credit. Private lessons: voice, piano, organ, winds, brass, strings, and percussion. Students who sing or play a traditional band or orchestra instrument at the intermediate level or better may enroll for any of the ensembles listed below. Students will register at the beginning of A term and receive 1/6 unit at the end of B term for participation in both terms. Students may also register at the beginning of C term and receive 1/6 unit at the end of D term for participation in both terms. Students may apply up to 1/3 unit of performing ensembles to the Humanities and Arts course requirement.

Department

Music

Units 1/3

Philosophy

PY 1731/RE 1731 : Introduction to Philosophy and Religion

This course provides an overview of key concepts, methods and authors in both fields. These introduce the student to the types of reasoning required for the pursuit of in-depth analysis in each discipline. Emphasis on topics and authors varies with the particular instructor.

Department

Philosophy

Religion

Category

Category I (offered at least 1x per Year)

Units 1/3

PY 2711 : Epistemology

Epistemology is the branch of philosophy inquiring into the nature and conditions of knowledge and truth. Epistemologists ask such questions as: How should we define knowledge? Is knowledge generated by reason or experience? How has knowledge of nature been represented in Western philosophy and science? Is knowledge objective? What constitutes adequate justification for holding a belief? Do attributions of epistemic credibility vary among knowers from different social, cultural, and economic locations? How do power and ideology shape our experiences of the world? Students explore questions such as these and others as they submit their own beliefs about the nature of knowledge to philosophical examination. The course readings and situating context for inquiry will vary each time the course is taught, with each iteration focusing on a particular period or school of philosophical thought. Possible contexts include seventeenth century philosophy or other periods in the history of philosophy, critical theory, pragmatism, analytic philosophy, phenomenology, and feminist philosophy. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Philosophy

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

none

PY 2712 : Social and Political Philosophy

This course examines metaphysical and moral questions that philosophers have raised about social and political life. Among questions treated might be: What are the grounds, if any, of the obligation of a citizen to obey a sovereign? Are there basic principles of justice by which societies, institutions and practices are rightly evaluated? What is democracy, and how can we tell if an institution or practice is democratic? To what degree do economic institutions put limits on the realization of freedom, democracy and self-determination? Readings might include excerpts from the works of Plato, Hobbes, Locke, Rousseau and Marx, as well as numerous contemporary philosophers. This course will be offered in 2021-22, and in alternating years thereafter.

Department

Philosophy

Category

Category II (offered at least every other Year)

Units 1/3

Suggested

familiarity with basic concepts in philosophy (as in PY/RE 1731).

PY 2713 : Bioethics

The purpose of this course is to evaluate the social impact of technology in the areas of biology/biotechnology, biomedical engineering and chemistry. The focus of the course will be on the human values in these areas and how they are affected by new technological developments. The course will deal with problems such as human experimentation, behavior control, death, genetic engineering and counseling, abortion, and the allocation of scarce medical resources. These problems will be examined through lectures, discussions and papers. This course will be offered in 2021-22, and in alternating years thereafter.

Department

Philosophy

Category

Category II (offered at least every other Year)

Units 1/3

Suggested

knowledge of key terms and concepts as given in PY/RE 1731 and PY/RE 2731.

PY 2716/RE 2716 : Gender, Race, and Class

This course examines the meanings of social categories such as gender, race, class, sexuality, ability, nationality, and species. What are the philosophical and religious foundations of the categorizations of beings operative in our contemporary cultures? How do attributions of same and different, normal and abnormal, rational and irrational, human and nonhuman shape social and political processes of inclusion and exclusion? Are social categories real, constructed, or both? This course focuses primarily on intersectional approaches to oppression and identity that see social categories such as gender, race, and class as mutually constitutive rather than separable. Course readings span a range of philosophical and religious traditions including Continental philosophy, analytic philosophy, Latina/o studies, feminist theory, queer theory, critical race theory, disability studies, and environmental studies. Students may not earn credit for both PY 2716 and RE 2716. This course will be offered in 2021-22, and in alternating years thereafter.

Department

Philosophy

Religion

Category

Category II (offered at least every other Year)

Units 1/3

PY 2717 : Philosophy and the Environment

This course will focus on the following questions: What is the scope of the current environmental crisis? What does this crisis reveal about the philosophical presuppositions and dominant values of our intellectual worldviews and social institutions? How can existing social theories help explain the environmental crisis? What implications does the crisis have for our sense of personal identity? What moral and spiritual resources can help us respond to it? Readings will be taken from contemporary and historical philosophers and naturalists.

Department

Philosophy

Category

Category I (offered at least 1x per Year)

Units 1/3

Suggested

familiarity with basic concepts in philosophy (as in PY/RE 1731).

PY 2718 : Existentialism and Phenomenology

This course focuses on two important movements in nineteenth and twentieth century philosophy, existentialism and phenomenology. Readings might include works by Kierkegaard, Dostoyevsky, Nietzsche, Husserl, Heidegger, Beauvoir, Sartre, Merleau-Ponty, Levinas, and Fanon, as well as contemporary readings by feminist, critical race, and queer theorists working within these traditions. Students will also encounter some of the great works of existentialist fiction and cinema. Themes that may be explored include the relationship between self and other, the tension between freedom and responsibility, the possibility of ethics after World War II, and the problem of ethical and political commitment in an alienating world.

Department

Philosophy

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

none

PY 2719 : Philosophy of Science

This course is an in-depth consideration of the meaning, value, and consequences of scientific inquiry. Questions explored may include: Does science yield truth? Are the results of scientific inquiry more a reflection of the workings of the human mind than of those of the external world? Do pivotal scientific concepts like gene, electron, photon, species, and ecosystem point to entities that actually exist? Does the history of science, which includes many refutations of theories once believed to be true, raise questions about whether currently accepted theories should be trusted? By what methods does a scientific community validate knowledge claims and how are these processes affected by social, political, and economic contexts? Does a scientist have a responsibility to conduct morally conscientious research? How does the development of technology affect our spiritual and moral characters? In what ways is science similar to religion and in what ways is it different? The focus of this course may vary each time it is offered from an examination of science in general to an investigation of the foundations of specific branches of science such as physics, biology, environmental science, or social science.

Department

Philosophy

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

PY/RE 1731, Introduction to Philosophy and Religion or PY/RE 2731, Introduction to Ethics.

PY 2731/RE 2731 : Ethics

This course offers a general introduction to modern moral theory. What makes one action wrong, and another right? What are our moral duties towards others? Do moral values change over time, making beliefs about right and wrong simply "relative," or are moral values objective, holding true for all people, everywhere, at all times? Should emotions play a role in ethical deliberation, or should we aspire to be purely rational when engaged in moral thought and action? Is it okay to cheat on an exam, so long as everybody else does it? Do we have a right to use animals in laboratory experiments? Is eating meat ethical? Is it wrong to share a racist or sexist joke? Should abortion be legal? Students will learn how to apply key moral concepts to real-world problems and situations after closely studying several moral theories, including utilitarianism, Kantianism, and feminist care ethics. Other topics covered include moral relativism, psychological hedonism, and ethical egoism.

Department

Philosophy

Religion

Category

Category I (offered at least 1x per Year)

Units 1/3

PY 2734 : Philosophy and Spirituality

Spirituality is a philosophical perspective which stresses the role of virtue in happiness and morality; a psychological perspective on emotions and desire; and an essential dimension of religious life. Found in all religions, it is also personally important for the tens of millions who describe themselves as "spiritual but not religious." This course will investigate the many dimensions of spiritual thought and practice, focusing on questions such as: What Similarities/differences exist among the spiritual teachings of traditional religions? What is a spiritual experience, a spiritual lesson, a spiritual life? What is the role of spiritual practices such as yoga, meditation, and prayer? What is the place of spirituality in medicine (e.g.,meditation as treatment for stress), our relation to nature (e.g., the experience of a sunset), and political life (e.g., Gandhi, King, spiritual environmentalism)? Beyond scientific knowledge, technological expertise, and common sense, is there such a thing as wisdom? This course will be offered in 2022-23, and in alternating years thereafter.

Department

Philosophy

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

PY/RE 1731, Introduction to Philosophy and Religion.

PY 3712 : Philosophy of Religion

This course will focus on philosophical questions concerning the following topics: the existence and nature of God; the compatibility of God and evil; the nature of religious faith and the relationship between religion, science and ethics; interpretations of the nature of religious language; the philosophically interesting differences between Western and Eastern religions; philosophical critiques of the role of religion in social life. Authors may include: Hume, Kant, Kierkegaard, Buber, Tillich, Daly, Nietzsche and Buddha. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Philosophy

Category

Category II (offered at least every other Year)

Units 1/3

Suggested

familiarity with basic religious concepts and terms (as in PY/RE 1731).

PY 3721/RE 3721 : Topics in Religion

This course is organized around an advanced or specialized topic in religion and provides preparation for HU 3900 Inquiry Seminars in philosophy and religion. The focus will vary, but the material will be drawn from a particular religious thinker, a particular religious tradition or a particular historical or contemporary problem. The topical theme of the class will be provided as a modified course title in the course description posted online.

Department

Philosophy

Religion

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

None.

RE 3711/PY 3711 : Topics in Philosophy

This course is organized around an advanced or specialized topic in philosophy and provides preparation for HU 3900 Inquiry Seminars in philosophy and religion. Emphasis on topics and authors will vary with instructor, but will typically involve the study of: a particular philosopher (e.g., Plato, Marx, Dewey, Arendt); a particular philosophical tradition (e.g., Pragmatism, Analytic Philosophy, Buddhism, Feminism); a particular philosophical problem or topic (free will, globalization, consciousness, social movement, justice); or a particular philosophical classic (Aristotle's Ethics, Hobbes's The Leviathan, Beauvoir's The Second Sex). The topical theme of the course will be provided as a modified course title in the course description posted online.

Department

Religion

Philosophy

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

None.

Religion

PY 1731/RE 1731 : Introduction to Philosophy and Religion

This course provides an overview of key concepts, methods and authors in both fields. These introduce the student to the types of reasoning required for the pursuit of in-depth analysis in each discipline. Emphasis on topics and authors varies with the particular instructor.

Department

Philosophy

Religion

Category

Category I (offered at least 1x per Year)

Units 1/3

PY 2716/RE 2716 : Gender, Race, and Class

This course examines the meanings of social categories such as gender, race, class, sexuality, ability, nationality, and species. What are the philosophical and religious foundations of the categorizations of beings operative in our contemporary cultures? How do attributions of same and different, normal and abnormal, rational and irrational, human and nonhuman shape social and political processes of inclusion and exclusion? Are social categories real, constructed, or both? This course focuses primarily on intersectional approaches to oppression and identity that see social categories such as gender, race, and class as mutually constitutive rather than separable. Course readings span a range of philosophical and religious traditions including Continental philosophy, analytic philosophy, Latina/o studies, feminist theory, queer theory, critical race theory, disability studies, and environmental studies. Students may not earn credit for both PY 2716 and RE 2716. This course will be offered in 2021-22, and in alternating years thereafter.

Department

Philosophy

Religion

Category

Category II (offered at least every other Year)

Units 1/3

PY 2731/RE 2731 : Ethics

This course offers a general introduction to modern moral theory. What makes one action wrong, and another right? What are our moral duties towards others? Do moral values change over time, making beliefs about right and wrong simply “relative,” or are moral values objective, holding true for all people, everywhere, at all times? Should emotions play a role in ethical deliberation, or should we aspire to be purely rational when engaged in moral thought and action? Is it okay to cheat on an exam, so long as everybody else does it? Do we have a right to use animals in laboratory experiments? Is eating meat ethical? Is it wrong to share a racist or sexist joke? Should abortion be legal? Students will learn how to apply key moral concepts to real-world problems and situations after closely studying several moral theories, including utilitarianism, Kantianism, and feminist care ethics. Other topics covered include moral relativism, psychological hedonism, and ethical egoism.

Department

Philosophy

Religion

Category

Category I (offered at least 1x per Year)

Units 1/3

PY 3721/RE 3721 : Topics in Religion

This course is organized around an advanced or specialized topic in religion and provides preparation for HU 3900 Inquiry Seminars in philosophy and religion. The focus will vary, but the material will be drawn from a particular religious thinker, a particular religious tradition or a particular historical or contemporary problem. The topical theme of the class will be provided as a modified course title in the course description posted online.

Department
Philosophy
Religion
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
None.

RE 2721 : Religion and Culture

The purpose of this course is to examine how the two institutions of religion and culture interact and mutually influence one another. To do this a variety of definitions of religion and culture will be presented as well as an analysis of how religion interacts with such cultural phenomena as economics, politics, the state, war and the basic problem of social change. The purpose of this is to obtain a variety of perspectives on both religion and culture so that one can begin to articulate more clearly the different influences that occur in the development of one's own personal history and the culture in which one lives.

Department
Religion
Category
Category I (offered at least 1x per Year)
Units 1/3
Suggested
knowledge of key terms and concepts as given in PY/RE 1731.

RE 2722 : Modern Problems of Belief

This course examines the ways in which religious problems of meaning have been encountered in the context of the eclipse of religion in Western culture from the Enlightenment to the present. The class emphasizes challenges presented to traditional belief systems by modern thought in areas such as the sciences, psychology, textual criticism, and historical events, as well as some religious responses to those challenges. How do religions respond to the limits of human intellectual capacity, limits of human endurance, and limits of moral comprehension?
This course will be offered in 2021-22, and in alternating years thereafter.

Department
Religion
Category
Category II (offered at least every other Year)
Units 1/3

RE 2725 : Religious and Spiritual Traditions

The primary aim of this course would be student literacy in global religions. The course examines, from historical, doctrinal, scriptural and/or philosophical perspectives, major world religious and spiritual traditions. Attention will be given to the social context in which these religious traditions developed and will examine their continuing influence. Students taking RE2725 should not receive credit for RE2723 or RE2724, since RE2725 replaces them.

Department
Religion
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
None

RE 3711/PY 3711 : Topics in Philosophy

This course is organized around an advanced or specialized topic in philosophy and provides preparation for HU 3900 Inquiry Seminars in philosophy and religion. Emphasis on topics and authors will vary with instructor, but will typically involve the study of: a particular philosopher (e.g., Plato, Marx, Dewey, Arendt); a particular philosophical tradition (e.g., Pragmatism, Analytic Philosophy, Buddhism, Feminism); a particular philosophical problem or topic (free will, globalization, consciousness, social movement, justice); or a particular philosophical classic (Aristotle's Ethics, Hobbes's The Leviathan, Beauvoir's The Second Sex). The topical theme of the course will be provided as a modified course title in the course description posted online.

Department

Religion
Philosophy

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

None.

RE 3723 : Religion, Gender & Sexuality

Patriarchal religious traditions are often characterized by masculine images of the Divine, cisgendered male religious authority, male-authored scriptures and a heteronormative gendered division of religious practices. As a result, men and cultural masculinity are differently valued than women and cultural femininity; this male-female binary leaves little room for practitioners who identify as nonbinary. In this discussion-focused course, we will engage representations of gender and sexuality in different traditions and their impact on larger social contexts from philosophical, theological and ethnographic perspectives. Among the questions we will explore: Why does the idea of a female or feminine YHWH, God or Allah bother us? Can feminine representations (such as the Devi, Shakti or Shekhinah) or nonbinary representations (such as two-spirit people in indigenous communities) facilitate gender equity? Do mystical traditions (such as the Zohar or Sufism) encourage gender fluidity? How do religions influence sexuality; how does sexuality intersect with creation myths and cosmogonies? Why is a Buddhist nun expected to bow to a Buddhist monk; why does the Catholic Church not recognize women, nonbinary and / or queer priests? This combination of theoretical and methodological conversations will offer students a forum in which to recast assumptions about individual and collective identity that permeate our cultural systems and structures.

Department

Religion

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

None. Students cannot receive credit for both RE 3723 and 2019-2020 and 2020-2021 Sections of RE 3721.

Spanish

ID 3525/SP 3525 : Spanish American Film/Media: Cultural Issues

Through Latin American and Caribbean films, and other media sources, this course studies images, topics, and cultural and historical issues related to modern Latin American and the Caribbean. Within the context and influence of the New Latin American Cinema and/or within the context of the World Wide Web, radio, newspapers, and television the course teaches students to recognize cinematographic or media strategies of persuasion, and to understand the images and symbols utilized in the development of a national/regional identity. Among the topics to be studied are: immigration, gender issues, national identity, political issues, and cultural hegemonies. Taught in advanced level Spanish. May be used toward foreign language Minor, or Major. This course will be offered in 2021-22, and in alternating years thereafter. This course satisfies the Inquiry Practicum requirement.

Department
Integrative & Global Studies
Spanish
Category
Category II (offered at least every other Year)
Units 1/3
Recommended Background
SP 2521 and SP 2522, and SP 3523.

ID 3526/SP 3526 : Comparative Business Environments

The basis of this course is a comparative study and analysis of specific Latin American and Caribbean business practices and environments, and the customs informing those practices. ID 3526/SP 3526 focuses on countries such as Mexico, Argentina, Chile, Puerto Rico, and Costa Rica. The course's main objective is to study communication strategies, business protocol, and negotiation practices in the countries mentioned above. Through oral presentations and written essays, students will have the opportunity to explore other countries in Latin America and the Caribbean. Taught in advanced level Spanish. May be used toward foreign language Minor, or Major. This course will be offered in 2022-23, and in alternating years thereafter. This course satisfies the Inquiry Practicum requirement.

Department
Integrative & Global Studies
Spanish
Category
Category II (offered at least every other Year)
Units 1/3
Recommended Background
SP 2521 and SP 2522.

ID 3527/SP 3527 : Technical and Business Spanish

The course focuses on the linguistic concepts, terminology, and grammar involved in business and technical Spanish. Students will be required to produce and edit business documents such as letters, job applications, formal oral and written reports, etc. The objective of this course is to help students develop the basic written and oral communication skills to function in a business environment in Latin America and the Caribbean. This course will be offered in 2021-22, and in alternating years thereafter.

Department
Integrative & Global Studies
Spanish
Category
Category II (offered at least every other Year)
Units 1/3
Recommended Background
SP 2521 and SP 2522.

ID 3529/SP 3529 : Caribbeanness: Voices of the Spanish Caribbean

A survey of Caribbean literature and arts that takes a multimedia approach to examining the different voices that resonate from the Spanish Caribbean and what appears to be a constant search for identity. By studying the works of major authors, films, music and the plastic arts, we will examine the socio-cultural context and traditions of this region in constant search for self-definition. Special attention will be given to the influential role ethnicity, colonialism, gender and socio-economic development play in the interpretation of works from Puerto Rico, Cuba, the Dominican Republic, Colombia and Venezuela as well as those of the Caribbean diaspora. This course is taught in Spanish. This course will be offered in 2021-22, and in alternating years thereafter.

Department

Integrative & Global Studies

Spanish

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

SP3521 (Advanced Spanish I) and SP 3522 (Advanced Spanish II) or equivalent.

ID 3530/SP 3530 : Spanish Film/Media: Cultural Issues

Through Spanish films, and other media sources, this course studies images, topics, and cultural and historical issues that have had an impact in the creation of a modern Spanish nation. This course focuses on current political and ideo-logical issues (after 1936), the importance of Spanish Civil War, gender identity, and class, cultural and power relationships. This course is taught in Spanish. This course will be offered in 2022-23, and in alternating years thereafter. This course satisfies the Inquiry Practicum requirement.

Department

Integrative & Global Studies

Spanish

Category

Category II (offered at least every other Year)

Units 1/3

ID 3531/SP 3531 : Contemporary Us Latino Literature & Culture

This course introduces students to the field of Latino studies, paying particular attention to the cultural productions of U.S. Latinos in film, theater, music, fiction writing and cultural criticism. At the same time that this course reflects upon a transnational framework for understanding the continuum between U.S. Latinos and Latin American/Caribbean communities, we closely examine more U.S. based arguments supporting and contesting the use of Latino as an ethnic-racial term uniting all U.S. Latino communities. We examine the ways in which U.S. Latinos have manufactured identities within dominant as well as counter cultural registers. In this course, special attention is given to the aesthetics of autobiography and to how Latino writers experiment with this genre in order to address changing constructions of immigration, language, exile, and identity. This course is taught in English. This course will be offered in 2022-23, and in alternating years thereafter. This course satisfies the Inquiry Practicum requirement.

Department

Integrative & Global Studies

Spanish

Category

Category II (offered at least every other Year)

Units 1/3

SP 1523 : Elementary Spanish I

A very intensive course that will introduce the student to the basic grammar of Spanish, emphasizing the four language skills: listening, speaking, reading and writing. It will also introduce the student to different aspects of Hispanic cultures in the U.S. and in Spanish-speaking countries. Students who have taken Spanish in high school are urged to take a placement exam before enrolling in either level of Elementary Spanish. To enroll in this course, you must obtain written permission from one of the Spanish professors. This course is reservedfor those students with only one year of high school Spanish or with no previous experience. This course is closed to native speakers of Spanish and heritage speakers except with written permission from the instructor.

Department
Spanish
Category
Category I (offered at least 1x per Year)
Units 1/3

SP 1524 : Elementary Spanish II

A continuation of Elementary Spanish I. This course is closed to native speakers of Spanish and heritage speakers except with written permission from the instructor.

Department
Spanish
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
SP 1523.

SP 2521 : Intermediate Spanish I

A course designed to allow students to improve their written and oral skills, expand their vocabulary and review some important grammatical structures. Students will also read short stories and poems by some of the most representative Spanish American and Spanish authors, such as Horacio Quiroga, Jorge Luis Borges, Gabriela Mistral and Ana Marfa Matute. This course is closed to native speakers of Spanish and heritage speakers except with written permission from the instructor.

Department
Spanish
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
Elementary Spanish II.

SP 2522 : Intermediate Spanish II

A continuation of Intermediate Spanish I. This course is closed to native speakers of Spanish and heritage speakers except with written permission from the instructor.

Department
Spanish
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
SP 2521.

SP 3521 : Advanced Spanish I

A course that continues to improve students' language skills while deepening their understanding of Hispanic cultures. Some of the topics studied are: the origins of Hispanic cultures in Spain and Spanish America; family; men and women in Hispanic societies; education; religion. This course is closed to native speakers of Spanish except with written permission from the instructor.

Department
Spanish
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
Intermediate Spanish II.

SP 3522 : Advanced Spanish II

A continuation of Advanced Spanish I. This course satisfies the Inquiry Practicum requirement. This course is closed to native speakers ofiSpanish except with written permission from the instructor.

Department
Spanish
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
SP 3521.

SP 3523 : Topics in Latin American Culture

An introduction to various aspects of life in Latin American countries from early times to the present. Focusing on the social and political development of Latin America, the course will reveal the unity and diversity that characterize contemporary Latin American culture. Typical topics for study include: the precolumbian civilizations and their cultural legacy; the conquistadores and the colonial period; the independence movements; the search for and the definition of an American identity; the twentieth-century dictatorships; and the move toward democracy. This course will be offered in 2022-23, and in alternating years thereafter. This course satisfies the Inquiry Practicum requirement.

Department
Spanish
Category
Category II (offered at least every other Year)
Units 1/3
Recommended Background
SP 3521 (Advanced Spanish I) and SP 3522 (Advanced Spanish II) or equivalent.

SP 3524 : Spanish-American Literature in the Twentieth Century

This course, taught in the Spanish language, focuses on the major literary movements in Spanish America, from the "Modernista" movement at the turn of the century to the Latin American "Boom" of the 1960s to the political literature of the '70s and '80s. The work of representative authors, such as Ruben Dario, Julio Cortazar, Rosario Castellanos, Elena Poniatowska, will be discussed. This course will be offered in 2021-22, and in alternating years thereafter. This course satisfies the Inquiry Practicum requirement.

Department
Spanish
Category
Category II (offered at least every other Year)
Units 1/3
Recommended Background
SP 3521 (Advanced Spanish I) and SP 3522 (Advanced Spanish II) or equivalent.

SP 3528 : Spanish Culture and Civilization

This course is an introduction to various aspects of life in Spain, from early times to the present. The main focus is on Spain's social, political, and cultural development and its experience of diversity within its European context. Typical topics for study include: The Reconquista and the Arab influence in Spanish culture, the Spanish monarchy, its evolution into a democracy, the development of modern politics, the importance of the Spanish Civil war, and the influence of writers (such as Federico Garcia Lorca), painters (such as Pablo Picasso), and art in general in modern Spanish culture. This course is taught in Spanish. This course will be offered in 2021-22, and in alternating years thereafter. This course satisfies the Inquiry Practicum requirement.

Department
Spanish
Category
Category II (offered at least every other Year)
Units 1/3
Recommended Background
SP3521 (Advanced Spanish I) and SP 3522 (Advanced Spanish II) or equivalent.

SP 3532 : Studies in Spanish Literature: Artistic Expression and Nation Building

This course introduces students to the study of Spanish literature through analytical readings of essays, poetry, drama, and fiction of representative Spanish writers from medieval to contemporary times. The selected authors to be studied reflect Spanish society's cultural and political efforts conducive to a nation building process. Among the topics to be covered are: Literary and artistic movements, nationalist and religious discourses, cultural miscegenation, gender issues, regional, political and class conflicts, the role of the intellectual, and strategies for the construction of identities. This course is taught in Spanish. This course will be offered in 2022-23, and in alternating years thereafter. This course satisfies the Inquiry Practicum requirement.

Department
Spanish
Category
Category II (offered at least every other Year)
Units 1/3
Recommended Background
SP 3522 and SP 3528.

SP 3533 : Ecocrítica: Environmental Cultural Production in Latin America

This upper-level Spanish course explores the many ways in which Latin American authors, artists, filmmakers, photographers, and thinkers have responded to environmental concerns from colonial times to present day. Starting with Europeans' first impressions of the New World, we will grapple with the interplay between local cultures and the expansion of global capitalism in Latin America by analyzing literary and cultural representations of, for instance, resource extraction of rubber, wood, and petroleum in the Amazon (Brazil, Perú, Ecuador); *maquiladora* contamination and environmental migration in the borderlands (U.S.-Mexico); water defenders and neoliberalism (Chile, Bolivia); indigenous social movements in defense of land & nature (Ecuador); eco-feminist parallels between oppression of women and nature (Honduras, Colombia); and natural disasters, especially in the age of the Anthropocene (Mexico, Puerto Rico). We will explore these issues and more to unearth the role of Latin American cultural production in bearing witness to and generating awareness of environmental crises. While always accounting for the region's complex and interwoven history of coloniality, inequality, and dependency, we will look for environmental justice solutions proposed at the intersection of art and activism. Several questions will guide our interpretations, which will be grounded in ecocritical theory: what do the studied works aim to achieve by appealing to harmony between the human and the non-human? What similarities or differences exist across countries, contexts, and genres? And how does Latin America's ecological consciousness differ from that of other peripheries and centers? This course would be especially beneficial to students interested in project work at WPI's Project Centers in Latin America and the Caribbean and would count toward the HUA Requirement in Spanish, International and Global Studies, and Latin American & Caribbean Studies.
This course will be offered in 2021-22, and in alternating years thereafter.

Department
Spanish
Category
Category II (offered at least every other Year)
Units 1/3
Recommended Background
Advanced Spanish and content courses related to Latin America

SP 3534 : Intersections of Science, Engineering, Art, Literature, and Film in Latin America and the Caribbean

This course explores past and present intersections between the arts and sciences in Latin America and the Caribbean through a multidisciplinary and interdisciplinary approach. The purpose of this course is to examine areas or interaction between the arts, films, and literature with selected areas of knowledge related to STEM. In this manner, Latin America and the Caribbean are represented as in a creative and critical dialogue with aspects of Modernity and Modernization. This course is especially appropriate for students who expect to complete their IQP and MQP at WPI project centers in Latin America and the Caribbean.
This course will be offered in 2021-22, and in alternating years thereafter.

Department
Spanish
Category
Category II (offered at least every other Year)
Units 1/3

Theatre

EN 1221/TH 1221 : Introduction to Theatre on Page and Stage

This introductory course gives students a basic understanding of theatrical productions and theatre vocabulary through an investigation of how a play moves from the page to the stage. By touching on the various sub-disciplines of theatre (including playwriting, design, performance, and more), this course explores the role of theatre and art in the world.
Students may not receive credit for EN 1221 & TH 1221.

Department
Theatre
English
Category
Category I (offered at least 1x per Year)
Units 1/3

EN 2500/TH 2500 : Fundamentals of Technical Theatre

This course introduces students to a variety of technical theatre disciplines, including scenery, lighting, sound, props, and costumes. Students will explore each technical element through a combination of lectures, demonstrations, and workshops, and will demonstrate their learning through group projects and other hands-on activities.
Students may not receive credit for TH 2500 and either EN 2222 or TH 2222.

Department
Theatre
English
Category
Category I (offered at least 1x per Year)
Units 1/3

TH 1800 : Club Theatre Production

This course captures student participation in club theatrical productions. \ Course requirements and syllabus are available from the instructor. Students may not enroll themselves in this course; anyone participating in a credit eligible club production will be invited to request credit; those who do will be enrolled by the instructor. This course may be repeated for credit on different productions. *Only 2/3 units of credited production work (TH 1800 and TH 2800) may be counted toward the Humanities & Arts Requirement.*

Department
Theatre
Category
Category I (offered at least 1x per Year)
Units 1/6

TH 2100 : Fundamentals of Acting

This course is designed to give students fundamental tools and techniques for acting in the theatre. These include concentration, relaxation, imagination, observation, communication, sensory awareness, and basic script analysis. Drawing on the “Stanislavski Method,” and using character analysis and scene study, it will include exploration of objectives, tactics, obstacles, action, conflict, subtext, and characterization. It will do this through in-class exercises, as well as monologue and scene work from a variety of plays. Beyond acting skills, the student will learn valuable skills in public speaking and in conveying clear, complex ideas.

Students may not receive credit for TH 2100 and TH 1100.

Department
Theatre
Category
Category I (offered at least 1x per Year)
Units 1/3

TH 2400 : Fundamentals of Theatrical Design

This course will explore the principles and practices of theatrical design including script analysis, research, concept development, and collaboration. Students will learn to engage in theatrical storytelling through a variety of design disciplines (scenery, costumes, lighting, sound), and will develop a basic understanding of how these elements fit together. *Students may not receive credit for TH 2400 and TH 111X.*

Department
Theatre
Category
Category I (offered at least 1x per Year)
Units 1/3

TH 2800 : Departmental Theatre Production

This course captures student participation in departmental theatrical productions. Depending on the size of their role, students may earn 1/3 unit, 1/6 unit, or no credit. Course requirements & syllabus are available from the instructor. Students may not enroll themselves in this course; anyone wishing to participate in a departmental production should contact the Theater faculty during the previous semester. This course may be repeated for credit on different productions. *Only 2/3 units of credited production work (TH 1800 & TH 2800) may be counted toward the Humanities & Arts Requirement.*

Department

Theatre

Category

Category I (offered at least 1x per Year)

Units 1/3

TH 3200 : Special Topics in Dramatic Literature

In this course, students will learn to examine plays as works of literature and blueprints for performance. Through reading, discussion, and analysis, students will explore how playwrights engage social issues, respond to cultural trends, and provide entertainment through the medium of drama. Each offering will focus on works of dramatic literature within a specific period, genre, theme, or culture, such as: Modernism, Restoration, Musicals, Melodrama, Science Plays, LGBTQ+ Stories, Latinx Writers, or South African Drama. *Students may repeat this course for credit with different topics.*

Department

Theatre

Category

Category I (offered at least 1x per Year)

Units 1/3

TH 3240 : Playwriting

Playwright. Wright – a maker. She creates a world on the stage through action, dialogue, and character. In this course, students will learn to write for the theatre – to make plays – through study, discussion, and practice. Working from foundational ideas of the well-made play, it will draw upon various analytic theories of theater to examine the structure of plays. Through exercises and studio-type critique, students will create and develop their own plays.

This course will be offered in 2021-22, and in alternating years thereafter.

Students may not receive credit for TH 3240 and TH 2219.

Department

Theatre

Category

Category II (offered at least every other Year)

Units 1/3

TH 3300 : Special Topics in Performance Studies

This course will use the multidisciplinary approach of performance studies to examine specific theatrical traditions, movements, or approaches. Through reading/viewing, discussion, and practical exercises, students will explore the interactions of various theatrical sub-disciplines (such as directing, design, playwriting, acting, etc.) as well as the relationship of performance to adjacent fields such as sociology, geography, history, and politics. Each offering will focus on a specific type of performance, such as: Documentary Theatre, Audience-Driven/Interactive Performance, Theatre for Social Change, Religious & Ritual Performance, Puppetry, or Physical Theatre.

Students may repeat this course for credit with different topics.

Department

Theatre

Category

Category III (offered at discretion of dept/prgm)

Units 1/3

TH 3510 : Scenic Fabrication

This course will immerse students in the scenic fabrication process for a department theatre production. As members of the show's crew, students will plan, build, paint, install, and eventually remove all scenic elements, in collaboration with the show's technical staff and design team. Additionally, students may learn about the design process and other related activities. Students will demonstrate their learning by participating in the build process and other assigned projects. *Students may not receive credit for TH 3510 and TH 320X.*

Department

Theatre

Category

Category I (offered at least 1x per Year)

Units 1/3

TH 3800 : Minor Capstone

To complete the Theatre Minor, students must engage in a faculty-supervised, research-driven investigation of a specific topic within theatre. This experience is typically paired with a significant role on a departmental production. Course requirements & syllabus are available from the instructor. Students may not enroll themselves in this course; anyone wishing to complete a minor capstone should contact the Theatre faculty during the previous semester.

Department

Theatre

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

All other Theatre minor requirements must be completed before taking this course.

Writing (WR) and Rhetoric (RH)

IMGD 2450/WR 2450 : Narrative Design for Interactive Media and Games

This course will introduce key narrative concepts and skills necessary to craft linear and branching experiences in games and interactive media. These lessons can be of fundamental value to all interactive media and any development role. Topics covered may include world-building, writing within intellectual property, lore creation, environmental storytelling, and quest design. Students will work in small groups throughout the course to provide feedback and practice reciprocal creative roles in narrative creation.

Students may not receive credit for both 2450 and IMGD/WR 3400.

Department

Interactive Media and Game Development

Writing (WR) and Rhetoric (RH)

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

Design and development fundamentals.

IMGD 3450/WR 3450 : Writing Characters for Interactive Media & Games

This writing-intensive course reinforces narrative skills to achieve proficiency in character creation and dialogue for interactive media, including a survey of character writing techniques across different media and an examination of what changes when interactivity is added. Coursework will involve major forms of game writing, suitable for inclusion in a portfolio. Topics covered may include character exposition, development of rich playable and non-playable characters, short voice-over audio, interactive dialogue and interactive character arcs, and game character design.

Students may not receive credit for both IMGD/WR 3450 and IMGD/WR 2400.

Department

Interactive Media and Game Development

Writing (WR) and Rhetoric (RH)

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

Previous experience with story structure and writing for interactive media, such as that provided by IMGD/WR 2450 (formerly numbered IMGD/WR 3400).

WR 1010 : Elements of Writing

This course is designed for students who wish to work intensively on their writing. The course will emphasize the processes of composing and revising, the rhetorical strategies of written exposition and argumentation, and the reading and citation practices central to academic inquiry. In a workshop setting, students will write a sequence of short papers and complete one longer writing project based on multiple source texts; learn to read critically and respond helpfully to each other's writing; and make oral presentations from written texts. Where applicable, the topical theme of the class will be provided via the Registrar's office.

Department

Writing (WR) and Rhetoric (RH)

Category

Category I (offered at least 1x per Year)

Units 1/3

WR 1011 : Writing About Science & Technology

This course will examine the appropriate dissemination of scientific information in common science writing genres such as science journalism, consulting reports and white papers, and policy and procedure documents. In a workshop setting, students will write and revise documents th at promote broad understanding of scientific research and analysis of specialized knowledge. Course lectures and discussions investigate ethics of scientific reporting and teach students how to recognize deceptive texts and arguments (both quantitative and qualitative). The course is reading and writing intensive and is intended for students with backgrounds in a scientific discipline who are interested in applying their disciplinary knowledge.

Department

Writing (WR) and Rhetoric (RH)

Category

Category I (offered at least 1x per Year)

Units 1/3

WR 1020 : Introduction to Rhetoric

This course will apply classical and modern rhetorical concepts to analyze various texts and speeches in order to identify the means of persuasion to a particular end. Students will write short analytical papers that critically assess various rhetorical and communicative approaches. The goal of this course is to enable students to see rhetoric in action in order to both engage with the material critically as well as produce effective discourse to meet various situations.

Department

Writing (WR) and Rhetoric (RH)

Category

Category I (offered at least 1x per Year)

Units 1/3

WR 2010 : Elements of Style

This course will cover basic principles of prose style for expository and argumentative writing. Students will learn to evaluate writing for stylistic problems and will learn revision strategies for addressing those problems. The ultimate goal of the course is to help students write sentences and paragraphs that are clear, concise, and graceful. In the first part of the course, students will review parts of speech, basic sentence types, and sentence and paragraph structure in order to understand how sentences are put together and the impact their construction has on readers. Then, through hands-on writing exercises and extensive revision of their own and others' writing, students will learn strategies for tightening their prose (concision), achieving "flow" (cohesion and coherence) and improving usage (language specificity and precision).

Department

Writing (WR) and Rhetoric (RH)

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Basic knowledge of rhetorical writing (e.g., WR 1010, Elements of Writing, WR 1011, Writing About Science & Technology, or WR 1020, Introduction to Rhetoric.

WR 2210 : Business Writing and Communication

This course emphasizes the standard written genres of professional, workplace communication. Students will analyze the history, purposes, conventions, and social consequences of a variety of business communications, focusing on digital and print correspondence, reports, and proposals directed to internal and external audiences. Students will learn about the culture of a professional environment and the role of writing in structuring identity and relationships within that context. Classes will be conducted as interactive writing workshops in which students assess and respond to rhetorical scenarios and sample texts from a variety of professional worksites. Students will create portfolios, producing professional writing samples they may use on the job market. Suggested background: WR 1010 or WR 1011

Department

Writing (WR) and Rhetoric (RH)

Category

Category I (offered at least 1x per Year)

Units 1/3

WR 2310 : Visual Rhetoric

This course explores how visual design is used for purposes of identification, information, and persuasion. It looks at many modes of visual communication, such as icons, logos, trademarks, signs, product packaging, infographics, posters, billboards, ads, exhibits, graffiti, page layout, films, television, videogames, and web sites. The course provides an overview of the history of graphic design movements, as well as analytical tools to understand how visual design encodes messages and the role visual communication plays in contemporary culture. Students will write about and create a number of visual media in this project-centered class.

Department

Writing (WR) and Rhetoric (RH)

Category

Category I (offered at least 1x per Year)

Units 1/3

Suggested

WR 1010

WR 2500 : Writing in the Life Sciences

Writing in the Life Sciences will provide students with an introduction to academic writing within the disciplines that comprise the Life Sciences.
Topics will include:

- Ethics and research integrity as it pertains to research design, documentation, reporting, and communicating results to specialist and non-specialist audiences
- Fundamentals of writing in the Life Sciences including definitions and technical vocabulary, technical style, documentation, revising and editing
- Human factors that influence health including social determinants of health and health disparities
- Important documents in the Life Sciences including literature reviews and synopses, laboratory reports, proposals, and research presentations.

The course will also include writing for non-specialist audiences and newer methods of science communication including social media.
Students may not receive credit for both WR 2500 and WR 250X.
This course will be offered in 2021-22, and in alternating years thereafter.

Department

Writing (WR) and Rhetoric (RH)

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

One introductory course (1000 level) in professional writing in which students have translated scientific writing for diverse audiences (e.g.: WR 1011, Writing about Science & Technology). Foundational life sciences courses with emphasis in anatomy and physiology are also recommended.

WR 3011 : Teaching Writing

Teaching Writing introduces students to the theory and practice of written composition. Students research and read about the writing process and how best to support it through the practice of explicit teaching and tutoring. They learn specific strategies that can support writers as they plan, draft, and revise written work in a number of genres, and they study effective ways to provide helpful feedback on drafts. They also learn about and practice navigating the social, political and interpersonal dynamics of the teacher/tutor-student relationship through a tutoring internship at the Writing Center and through assignments prompting them to develop lesson plans and instructional handouts. This course will help students improve their own writing and read their own and others' writing more critically. It will be especially useful for those who plan to teach or tutor writing in the future. This course will be offered in 2021-22, and in alternating years thereafter.

Department

Writing (WR) and Rhetoric (RH)

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

WR 1010 Elements of Writing

WR 3112 : Rhetorical Theory

Rhetoric concerns both the art of mastering the available means of persuasion and the study of how oral, written, and visual communication projects the intentions of individuals and groups, makes meanings, and affects audiences. The purpose of this course therefore is two-fold. It is intended to help students become more effective communicators by learning about the rhetorical situation and various rhetorical techniques, and it is designed to help them understand how various forms of communication work by learning some of the philosophies and strategies of rhetorical analysis.

Department

Writing (WR) and Rhetoric (RH)

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Introduction to Rhetoric

WR 3210 : Technical Writing

Technical writing combines technical knowledge with writing skills to communicate technology to the world. This course introduces the fundamental principles of technical communication, and the tools commonly used in the technical writing profession. Topics include user and task analysis, information design, instructional writing, and usability testing. Students learn to use the technical writing process to create user-centered documents that combine text, graphics, and visual formatting to meet specific information needs. Students create a portfolio of both hardcopy and online documentation, using professional tools such as FrameMaker, Acrobat, and RoboHelp.

Department

Writing (WR) and Rhetoric (RH)

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

WR 1010, or equivalent writing course.

WR 3214 : Writing About Disease & Public Health

This writing workshop focuses on the purposed and genres of writing about disease and public health. We will consider how biomedical writers communicate technical information about disease and public health to general audiences; how writers capture the human experience of disease and health care; how writers treat the public policy implications of disease; and how writers design publicity to promote public health. We will examine such genres as the experimental article, news reports, medical advice, profiles, commentary, and public health messages.

Department

Writing (WR) and Rhetoric (RH)

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

WR 1010 Elements of Writing or equivalent writing courses.

WR 3300 : Cross-Cultural Communication

This course will examine how people from differing cultural backgrounds communicate, in similar and different ways among themselves, and how they endeavor to communicate across cultures. Students will develop a personal and theoretical understanding of the cultural origin of people's values, ideologies, habits, idiosyncrasies, and how they affect communication across cultural, racial, ethnic and gender lines. Through observing, studying and experiencing incidents of cross-cultural communication, they will begin to examine and develop skills that are necessary for effective understanding and for successful communication among majority and minority groups. This course will be offered in 2022-23, and in alternate years thereafter.

Department

Writing (WR) and Rhetoric (RH)

Category

Category II (offered at least every other Year)

Units 1/3

WR 4111 : Research Methods in Writing

This methodology course introduces students to issues in the study of writing such as the history and uses of literacy, the relationship of thought to language, the role of writing in producing knowledge, and research on composing. The focus of the course will be on professional and academic writing. In this project-based class, students will develop research questions, construct a relevant method study, and carry out that study. The purpose of this course is to add to students analytical approaches to writing and communicative situations.

Department

Writing (WR) and Rhetoric (RH)

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

WR 1010 Elements of Writing, WR 2310 Rhetoric of Visual Design, WR 3112 Rhetorical Theory.

WR 4210 : Medical Writing

Medical Writing will provide students with advanced opportunities to create clinically-oriented documents about disease, treatment, and medical research. Students will learn how to develop, structure, and present medical reports that integrate anatomy and physiology, disease history (including associated human and environmental factors), epidemiology, clinical presentation, differential diagnosis, and prognosis. The course will operate as a series of student projects in which students create scientific documents from major disease categories. The course will be focused on disease characterization for more advanced audiences and preparation for future graduate and professional writing in medicine or the life sciences.
Students may not receive credit for both WR 4210 and WR 421X.
This course will be offered in 2021-22, and in alternating years thereafter.

Department
Writing (WR) and Rhetoric (RH)
Category
Category II (offered at least every other Year)
Units 1/3
Recommended Background
Prior courses or projects (GPS, IQP) in health, medicine, or science writing. Exposure to anatomy and physiology would be helpful. The course is designed for 3rd and 4th year students with a strong interest in pursuing careers or continued education in medicine or public health.

Interactive Media and Game Development

AR 2048/IMGD 2048 : Technical Art and Character Rigging

This course will focus on making digital art functional in a video game environment. Students will learn the skills necessary to create and optimize their art assets through several creative and technical solutions that are all geared towards making high quality game art. This course will allow students to form a greater understanding of the bridge between pure art creation and interactive art implementation into a game engine. The course explores the many problems and technical restrictions one is faced with when trying to implement anything from animated characters to textures and focuses on how one can creatively apply technology to achieve high quality results. Topics covered include: creating complex character rigs, optimizing character meshes for rigging, shader creation, optimizing UV space and baking texture files and lighting.

Department
Interactive Media and Game Development
Art History/Architecture
Category
Category II (offered at least every other Year)
Units 1/3
Recommended Background
Basic knowledge of 3D modeling, texturing and animation (IMGD 2101 and IMGD 2201 or equivalent).

AR 2101/IMGD 2101 : 3D Modeling I

3D modeling is concerned with how to render created forms in a virtual environment. This course covers 3D modeling applications in video game development, film production, product design and fine art. Topics may include creating and armature, modeling organic and hard surfaces and sculpting using traditional techniques applied to a 3D model. Students will create works suitable for presentation in professional quality portfolio.

Department
Art History/Architecture
Interactive Media and Game Development
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
AR 1100 and AR 1101.

AR 2222/IMGD 2222 : 2D Animation I

2D Animation I teaches students how to draw, pose, breakdown and in-between characters for 2D animation, focusing on weight, balance, timing, and movement to achieve well-structured and fluid animation. Lectures and projects are conducted to train students in the twelve classical animation principles using digital 2D media. Projects and lectures are designed to practice the fundamentals of traditional frame-by-frame and hand-drawn character animation.

Department

Art History/Architecture

Interactive Media and Game Development

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Basic knowledge of figure drawing (AR 2202) and digital art software (AR 1101) is recommended.

AR 2333/IMGD 2333 : 3D Animation I

3D Animation I teaches students how to use 3D animation software to apply classical animation principles into 3D work. Lectures focus on creating organic and compelling character animation through body mechanics, weight, and dynamic posing in addition to exposing students to learning how to think about character acting and staging within a 3D environment.

Department

Art History/Architecture

Interactive Media and Game Development

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Basic knowledge digital art software (AR 1101) is recommended.

Suggested

Basic knowledge of animation (IMGD 2222/AR 2222).

AR 2700/IMGD 2700 : Digital Painting

This course covers painting techniques as applied to texturing a 3D asset or illustration/conceptual art. Topics include are color theory, study of form, lighting, applying traditional painting ideas to the digital format, character design, generation of ideas and a history of digital painting. Each class features a demonstration on the topic followed by individual critique and study. Students work towards a final project that may be suitable for an Art portfolio.

Department

Art History/Architecture

Interactive Media and Game Development

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

AR 1101 (Digital imaging and Computer Art); AR 2202 (Figure Drawing)

AR 2740/IMGD 2740 : 3D Environmental Modeling

The objective of this course is to teach students how to create 3D environments and props for use in digital models, simulations, games, or animation. The course will examine different types of architecture used in 3D spaces. The students will learn how to create historical and fictional interior and exterior environments; to design, model, texture, and render in high details; and to import their creation into an engine for testing. Topics may include space, human scale, set design, surface texturing, and basic camera animation. Students may not receive credit for IMGD/AR 2740 and IMGD/AR 205X. This course will be offered in 2022-23, and in alternating years thereafter.

Department
Art History/Architecture
Interactive Media and Game Development
Category
Category II (offered at least every other Year)
Units 1/3
Recommended Background
Basic 3D modeling skills (AR 1101)

AR 3101/IMGD 3101 : 3D Modeling II

This course will build upon the skills learned in 3D MODELING with studies in life drawing/anatomy study and application towards completed character models. Students will create high resolution sculpts for real time game environments and animation. Topics covered will be character design as it applies to 3D MODELING, creating realistic design sculpts and incorporating them into a game environment as well as the study of anatomy as it applies to organic modeling.

Department
Art History/Architecture
Interactive Media and Game Development
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
AR 1101, IMGD 2101/AR 2101, AR 2202

AR 3200/IMGD 3200 : Interactive Electronic Arts

This course introduces students to techniques and processes for the creation of real-time, interactive works of art. Students learn to use electronic sensors and other tools for audio, graphics, and video processing, as well as design customized software interfaces to create interactive artworks that respond to users and their environment. The course also introduces students to the work of significant contemporary arts practitioners as well as their historical precedents, with a special emphasis on inter-media works that bridge visual art, music composition, and the performing arts. Topics may include electronic musical instruments and performance interfaces, computer vision, VJing, electronically-augmented dance, controller hacking, wired clothing, networked collaboration and mobile media, and algorithmic and generative art.

Department
Art History/Architecture
Interactive Media and Game Development
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
Animation (AR 2101/IMGD 2101 or equivalent), and exposure to digital audio or music and introductory programming.

AR 3210/IMGD 3210 : Human Figure in Motion

This course offers in-depth analysis of the human figure in action. Motion is analyzed and studied through drawing and sketching of live models, video clips, performance and pantomime, studying not only the physical exterior but also how thoughts and emotion are expressed through gesture. Students will develop skill in figure posing and staging for applications in animation, storyboards, comics, and illustration.
This course will be offered in 2021-22, and in alternating years thereafter.

Department
Art History/Architecture
Interactive Media and Game Development
Category
Category II (offered at least every other Year)
Units 1/3
Recommended Background
Observational and gesture drawing and color (AR 1101), experience drawing live model (AR 2202), composition skills and color (AR 2700/IMGD 2700).

AR 3222/IMGD 3222 : 2D Animation II

This course will build upon the techniques learned in AR 2222/IMGD 2222. Students will learn to apply the animation principles to character animation. Students are taught how to tell a compelling, character-driven story through a focus on character acting techniques such as body language, lip syncing, facial animation, and micro expressions. Additional topics covered may include sprites for games, biped and quadruped animation, and 2D animation pipelines. Students will create animated sequences that are intended to serve a narrative structure for games and other media.

Department
Art History/Architecture
Interactive Media and Game Development
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
Knowledge of digital 2D animation techniques and classical animation principles (IMGD/AR 2222).

AR 3333/IMGD 3333 : 3D Animation II

This course will build upon the techniques learned in IMGD/AR 2333. Students will learn to apply the animation principles with a focus on character acting and cinematic animation. Students are taught how to tell a compelling, character-driven story through a focus on acting techniques such as body language, lip syncing, facial animation, and micro expressions whilst incorporating digital cinematography techniques. Additional topics covered may include creating 3D simulations for hair and cloth, biped and quadruped animation, and 3D animation pipelines. Students will create animated sequences that are intended to serve a narrative structure for games and other media.

Department
Art History/Architecture
Interactive Media and Game Development
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
Knowledge of digital 3D animation techniques and classical animation principles (AR 2333/IMGD 2333).

AR 3700/IMGD 3700 : Concept Art and Creative Illustration

This course covers drawing as it applies to concept art and illustration. The course begins with study of a human model and representational drawing. Following this, students work on drawing from the mind and applying the lessons learned from the figure drawing to creating concept art and illustration. Topics covered are shape recognition and recalling, inventing from the mind, creative starters, study of form and light, visual composition and developing a personal approach, working with individual strengths to create a compelling visual design. Students create a series of concept art exercises and apply these skills towards a personal project of their own.

Department

Art History/Architecture
Interactive Media and Game Development

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

AR 2202 (Figure Drawing); AR 2700/ IMGD 2700 (Digital Painting)

CS 4100/IMGD 4100 : Artificial Intelligence for Interactive Media and Games

Algorithms and programming techniques from artificial intelligence (AI) are key contributors to the experience of modern computer games and interactive media, either by directly controlling a non-player character (NPC) or through more subtle manipulation of the environment. This course will focus on the practical AI programming techniques currently used in computer games for NPC navigation and decision-making, along with the design issues that arise when AI is applied in computer games, such as believability and real-time performance. The course will also briefly discuss future directions in applying AI to games and media. Students will be expected to complete significant software development projects using the studied techniques. This course will be offered in 2021-22, and in alternating years thereafter.

Department

Computer Science
Interactive Media and Game Development

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

Object-oriented design concepts (CS 2102 or CS 2103), algorithms (CS 2223), and knowledge of technical game development (IMGD 3000 or IMGD 4000).

CS 4300/IMGD 4300 : Graphics, Simulation, and Aesthetics

This course trains students to create accelerated simulations using Graphics Processing Unit (GPU) programming techniques, and to render the output of these simulations in aesthetically interesting ways. The aesthetic focus of the course is grounded by examining the histories of experimental animation, video synthesis, and the use of simulation in the digital arts. Students will evaluate the effectiveness of GPU-accelerated techniques for a variety of simulations and will create their own aesthetic explorations of appropriate simulations throughout the course.

Department

Computer Science
Interactive Media and Game Development

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

Students should have experience with graphics, web, or game engine programming and multimedia development. One of CS 4731 (Computer Graphics), CS 4241 (Webware), or IMGD 4000 (Technical Game Development II) should provide sufficient background for this course.

IMGD 1000 : Critical Studies of Interactive Media and Games

This course introduces non-technical studies of computer-based interactive media and games. The course develops a vocabulary for discussing games and other interactive media, and tools for analyzing them. Students are expected to provide written critiques using the critical approaches presented in the course. The games and other interactive media critiqued may be commercially available or under development.

Department
Interactive Media and Game Development
Category
Category I (offered at least 1x per Year)
Units 1/3

IMGD 1001 : The Game Development Process

This course discusses the process of game development. It examines the roles of different participants in the development process and how the technical development and the artistic development proceed in tandem. Group work is emphasized, especially the importance of collaboration between technical and artistic efforts. Students are expected to participate in game development using appropriate game development tools. Some sections of this course may be offered as Writing Intensive (WI).

Department
Interactive Media and Game Development
Category
Category I (offered at least 1x per Year)
Units 1/3

IMGD 1002 : Storytelling in Interactive Media and Games

This course explores different types of story within gaming and other interactive media. It delineates between linear, branching, and emergent storytelling, identifies hybrids, and finds new modes of making compelling narrative. A variety of games are discussed, including early text-based adventures, role-playing games, shooters, and strategy games. Students will construct characters, situations, and narratives through game play and scripted cut scenes. Students will explore and use visual storytelling techniques.

Department
Interactive Media and Game Development
Category
Category I (offered at least 1x per Year)
Units 1/3

IMGD 2000 : Social Issues in Interactive Media and Games

This course provides students with a realistic assessment of the potential and problems related to interactive media and games, especially computer games, and their effects on society. Topics include individual and group behavior, diversity, human responsibility, ethical and legal issues, and intellectual property. The course examines the issues from various points of view, and discover the political, social, and economic agendas of the people or groups championing those points of view. Students will write papers, participate in discussions, and research related topics.

Department
Interactive Media and Game Development
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
IMGD 1000.

IMGD 2001 : Philosophy and Ethics of Computer Games

This course introduces students to some of the political and ethical dimensions of the new entertainment modalities. Students will explore such issues as representation and power (e.g., gaming and disability, and race stereotyping in games), the phenomenology of virtual reality, capitalism and the commodification of leisure, gender and sexual violence, and cyberspace and democracy. Students will also develop critical tools for evaluating the ethical and social content of their own and others' games. In addition to writing several analytical papers on the critical theory of technology, students will be encouraged to work on game designs exploring philosophical or social themes. This course will be offered in 2021-22, and in alternating years thereafter.

Department

Interactive Media and Game Development

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

IMGD 1000.

IMGD 2030 : Game Audio I

This course serves as an introduction to game audio, where the basics of audio theory and production are discussed along with practical applications for use in game development. Topics may include music, sound effects, dialogue, soundscape design, digital signal processing, basic audio engine principles, and the aesthetic vs. technical considerations in game audio production. Lab exercises may include an introduction to audio editing and mixing, dynamics and effects processing, creating and timing sound effects to character animations, mixing for cinematics, and audio integration using a 3D engine. This course assumes no prior knowledge of audio production.

Department

Interactive Media and Game Development

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

IMGD 1000 and IMGD 1001.

IMGD 2450/WR 2450 : Narrative Design for Interactive Media and Games

This course will introduce key narrative concepts and skills necessary to craft linear and branching experiences in games and interactive media. These lessons can be of fundamental value to all interactive media and any development role. Topics covered may include world-building, writing within intellectual property, lore creation, environmental storytelling, and quest design. Students will work in small groups throughout the course to provide feedback and practice reciprocal creative roles in narrative creation.

Students may not receive credit for both 2450 and IMGD/WR 3400.

Department

Interactive Media and Game Development

Writing (WR) and Rhetoric (RH)

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

Design and development fundamentals.

IMGD 2500 : Design of Tabletop Strategy Games

The objective of the course is to teach students how to design board strategy games. The design principles are transferable to other types of games, such as computer games. Game quality issues such as rules unambiguity, depth, complexity, branching width, balance, and historical content are examined. Basic elements and types of game rules, such as map gridding, restricted play choices, resource limitations, and depths of game economics are discussed. Central to the course is the game design project: students design, playtest, and develop their own game. One two-hour laboratory a week covers play, and playtesting, and supports the game design project. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Interactive Media and Game Development

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

IMGD 1000

IMGD 2900 : Digital Game Design I

Software engineering and art production are the means of digital game development, but the end is an experience. Game design is the process of creating, describing, implementing and iteratively refining that experience. This team-oriented, project-based course provides opportunities for students to develop hands-on expertise with digital game design through a combination of practical implementation, in-class critique and playtesting. A focus of the course is the functional expression of design through the use of game engine scripting. Students keep a weekly journal of their design experiences. A final exam tests their knowledge of design concepts and terminology.

Department

Interactive Media and Game Development

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Intermediate programming experience (such as from CS 2102, CS 2103, or CS 1004), Knowledge of game studies (IMGD 1000 or equivalent) and the game development process (IMGD 1001 or equivalent).

IMGD 2905 : Data Analysis for Game Development

This course will cover basic concepts of probability and data analysis as they apply to the design and analysis of interactive media and games. Students will study appropriate use of probability distributions in the design of interactive experiences, and the use of data analysis methods to understand user behavior in games and other interactive experiences. Topics will include discrete and continuous probability distributions, programming techniques to produce samples from different distributions, descriptive statistics, exploratory data analysis and using existing tools to collect and analyze data from gameplay. This course counts toward the Quantitative Science component of the university-wide Mathematics and Science Requirement for IMGD majors only.

Department

Interactive Media and Game Development

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

High school algebra

IMGD 3000 : Technical Game Development I

This course teaches technical Computer Science aspects of game development, with the focus of the course on low-level programming of a computer games. Topics include 2D and 3D game engines, simulation-type games, analog and digital controllers and other forms of tertiary input. Students will implement games or parts of games, including exploration of graphics, sound, and music as it affects game implementation.

Department

Interactive Media and Game Development

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

CS 2303.

IMGD 3030 : Game Audio II

Game Audio II serves as an intermediate level audio design course, where digital recording principles and techniques are studied along with their practical applications for use in game development. Students will also gain deeper insight into 2-D vs. 3-D audio propagation, as well as learn more complex techniques in digital editing, mixing, signal processing, mastering, and playback strategies. Lab exercises may include interactive dialogue scripting and recording; loop-based music production; custom sound effects creation and Foley design; and audio engine integration. A team project will be the creation of a comprehensive game sound effects library over the course of the term. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Interactive Media and Game Development

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

Game Audio (IMGD 2030)

IMGD 3100 : Novel Interfaces for Interactive Environments

This course focuses on the design and evaluation of novel user interfaces that provide greater input and output expressiveness than the keyboard, mouse, or game pad. The course covers the related applications of immersive gaming, teleoperated robotics, and mobile users. Input sensors, such as those providing motion, attitude, and pressure data, are used to explore novel input methods, and how they may be effectively used to design innovative experiences. Through a combination of lecture and hands-on work, students learn to build prototype systems and to critically evaluate different alternatives. Students are expected to program several alternative input/output systems as part of this course This course will be offered in 2022-23, and in alternating years thereafter.

Department

Interactive Media and Game Development

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

IMGD 1001, and either CS 2301 or CS 2303

IMGD 3450/WR 3450 : Writing Characters for Interactive Media & Games

This writing-intensive course reinforces narrative skills to achieve proficiency in character creation and dialogue for interactive media, including a survey of character writing techniques across different media and an examination of what changes when interactivity is added. Coursework will involve major forms of game writing, suitable for inclusion in a portfolio. Topics covered may include character exposition, development of rich playable and non-playable characters, short voice-over audio, interactive dialogue and interactive character arcs, and game character design.

Students may not receive credit for both IMGD/WR 3450 and IMGD/WR 2400.

Department

Interactive Media and Game Development

Writing (WR) and Rhetoric (RH)

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

Previous experience with story structure and writing for interactive media, such as that provided by IMGD/WR 2450 (formerly numbered IMGD/WR 3400).

IMGD 3500 : Artistic Game Development I

This course focuses on the unique problems presented to the artist when working in game development. Students will learn game art pipelines and how to prepare art assets for use in game engines. Topics may include modular level design, 3D architecture, texturing and shaders, high poly and low poly workflows, environments, lighting, particle effects, and character animation for games. Students will create original art for compelling game experiences by designing their own levels.

Department

Interactive Media and Game Development

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

3D modeling (IMGD/AR 2101 and 3101), digital painting (IMGD/AR 2700), 3D animation (IMGD/AR 2333).

IMGD 3900 : Digital Game Design II

This team-oriented, project-based course will provide opportunities for students to deepen their experience and understanding of digital game design concepts through a combination of thorough design, practical implementation, playtesting and in-class game critique. Students will prepare and present design treatments, develop hands-on expertise with game scripting, and study methods of collecting and analyzing gameplay data. A final project and presentation will test their creativity and demonstrate their practical mastery of game design concepts. Data Analysis for Game Development.

Department

Interactive Media and Game Development

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

IMGD 2900: Digital Game Design I, and basic knowledge of statistical data analysis such as that provided by IMGD 2905:

IMGD 4000 : Technical Game Development II

This course focuses on the application of advanced Computer Science topics as they impact game development. Networking and distributed systems issues are addressed, including scalability and latency compensation techniques, for designing games for a online multi-player environments. AI, graphics and physics techniques specific to game development are discussed. Students will implement games or parts of games that apply advanced Computer Science topics.

Department

Interactive Media and Game Development

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

IMGD 3000.

IMGD 4030 : Advanced Topics in Interactive Audio

This course provides students the opportunity to gain hands-on proficiency with the complete audio development pipeline for interactive applications, from concept and asset creation to post-production and integration. Topics may include custom recording techniques; procedural audio generation; audio object states and conditions; asset management; automated effects processing; and spatial presentation of audio in stereo, surround and mixed/virtual reality formats.

Department

Interactive Media and Game Development

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

Prior experience with editing and mixing techniques on a digital audio workstation (such as provided by IMGD 2030), together with experience in studio and field recording of audio and voices (such as provided by IMGD 3030).

IMGD 4099 : Special Topics in IMGD

Arranged by individual faculty with special expertise, this course explores emerging and experimental topics that are not covered by the regular IMGD offerings. Content and format varies to suit the interests and needs of the faculty and students. Specific course descriptions are disseminated by IMGD program in advance of the offering. This course may be repeated for different topic offerings.

Department

Interactive Media and Game Development

Category

Category II (offered at least every other Year)

Units 1/6

Recommended Background

Varies depending on topic.

IMGD 4200 : History and Future of Immersive and Interactive Media

This course will familiarize students with the history of the development, deployment, commercialization, and evolution of immersive and active media. The lesson plan will cover a broad range of enabling technologies, such as geometric perspective drawing, pre-20th-century panoramic displays, photography and the stereoscope, sound recording and reproduction, motion pictures, radio and television, the planetarium, immersive and 3-dimensional cinema, and special attraction venues, with a particular focus on digital games. Current trends and future directions will also be considered. Students will attend seminars and lectures, read and discuss texts on media history and aesthetics, and write an original research paper. Midterm and final exams test students' knowledge and understanding of important events and developments. A student may not receive credit for both IMGD 4200 and IMGD 3200. This course will be offered in 2021-22, and in alternating years thereafter.

Department

Interactive Media and Game Development

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

IMGD 1000, and either IMGD 2000 or IMGD 2001.

IMGD 4403 : Motion Capture Techniques

This course will introduce students to the principles of motion capture as applied to the production of digital games and cinema. Topics will include the study of different forms of mocap technology, the design of efficient animation pipelines, techniques for combining keyed and mocap animation, and real-time capture into game engines. Students will gain experience in directing actors, blending hand-keyed animations, applying the laws of physics to motion data sets, building tools and troubleshooting captured data. Students cannot receive credit for both IMGD 4403 and IMGD 440X. This course will be offered in 2021-22, and in alternating years thereafter.

Department

Interactive Media and Game Development

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

Students should have knowledge of basic 3D animation principles and software such as is provided by IMGD/AR 2333: 3D Animation I. They should also have knowledge of structural anatomy and kinematics such as is provided by IMGD 2048: Technical Art and Character Rigging.

IMGD 4500 : Artistic Game Development II

This course focuses on the integration and organization of the various artistic elements used in game development. The course examines user interaction, interface design, and existing paradigms in current games. Students will combine elements of level design, animation, music, sound, and writing to create an aesthetically appealing game.

Department

Interactive Media and Game Development

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

IMGD 1002, IMGD 3500, MU 1611.

IMGD 4600 : Serious Games

This course explores the application of the technologies and design principles of interactive media and game development beyond traditional entertainment. The purpose of such applications is typically to change people's behaviors, knowledge and/or attitudes in diverse areas including health care, training, education, simulation, politics, marketing and art. Students read about, experiment with, compare and discuss examples, as well as the underlying philosophies and issues specific to this genre, such as domain analysis and rigorous evaluation. Students in groups also research a new application and produce a detailed design document and mock-up. Advanced programming skill is not required, but a background in game design is strongly recommended. This course will be offered in 2021-22, and in alternating years thereafter.

Department

Interactive Media and Game Development

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

IMGD 1001 and either IMGD 2000 or IMGD 2001.

IMGD 4700 : Advanced Storytelling: Quest Logic and Level Design

This course provides an in-depth examination of storytelling as it is currently done in 2D and 3D games through a study of quests and construction of gaming spaces. Level designers turn stories into games through building virtual spaces and populating them with non-player characters who have their own objectives. Cinematics are used to extend the narrative space. The course requires students to build multiple virtual spaces that have a history and a population with present needs. Students need to work out plotting through the logic of a quest, build several areas that supports that logic and create cinematics to extend their narrative space. Students may not receive credit for both IMGD 4700 and IMGD 403X. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Interactive Media and Game Development

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

IMGD 1002, or equivalent knowledge.

IMGD 4900 : Digital Game Design Studio

This studio course will provide students an opportunity to collaborate on the creation of an original game project, with an emphasis on the importance of scoping and a thorough, well-documented design. Students will form project teams, create a team Web site, and design, implement and test their project using industry-standard tools and methods. This course will be offered in 2021-22, and in alternating years thereafter.

Department

Interactive Media and Game Development

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

IMGD 3900 (Digital Game Design II)

IMGD 5000 : Game Design Studio

Department

Interactive Media and Game Development

Units 1/3

IMGD 5200 : History and Future of Immersive and Interactive Media

This course will familiarize students with the history of the development, deployment, commercialization, and evolution of immersive and active media. The lesson plan will cover a broad range of enabling technologies, such as geometric perspective drawing, pre-20th-century panoramic displays, photography and the stereoscope, sound recording and reproduction, motion pictures, radio and television, the planetarium, immersive and 3-dimensional cinema, and special attraction venues, with a particular focus on digital games. Current trends and future directions will also be considered. Students will attend seminars and lectures, read and discuss texts on media history and aesthetics, and write an original research paper. Midterm and final exams test students' knowledge and understanding of important events and developments. A student may not receive credit for both IMGD 3200 and IMGD 4200.

Department

Interactive Media and Game Development

Units 1/3

Suggested

An understanding of dominant themes and genres in video games

IMGD 5300 : Design of Interactive Experiences

Department

Interactive Media and Game Development

Units 1/3

International and Global Studies

INTL 1100 : Introduction to International and Global Studies

An introduction to the main concepts, tools, fields of study, global problems, and cross-cultural perspectives that comprise international and global studies. No prior background is required. Especially appropriate for students interested in any of WPI's global Project Centers.

Department

International and Global Studies

Category

Category I (offered at least 1x per Year)

Units 1/3

INTL 1200 : Introduction to Asia

This course will explore Asia through an interdisciplinary approach. We will examine tradition and modernity in some or all of four cultural regions—South Asia (India), East Asia (China),Southeast Asia (Vietnam or Thailand), Inner Asia (Tibet)—and globalization in Japan and/or Hong Kong. We will explore the cultural traditions of these various regions, paying special attention to history, religion, society. We will also consider modern developments in these same regions. The impact of colonialism, nationalism, revolution, industrialization and urbanization on the lives of Asian peoples will be illustrated through films and readings. No prior knowledge of Asian history or culture is expected.

Students may not receive credit for HU 1412 and INTL 1200.

Department

International and Global Studies

Category

Category I (offered at least 1x per Year)

Units 1/3

INTL 1300 : Introduction to Latin America

This course reviews the past and present of South America, Central America and the Caribbean through an interdisciplinary approach. It examines historical and contemporary issues related to social mobilization, cultural innovation, political activism, economic development, and environmental sustainability through the critical analysis of books, films, and creative arts from and about the region. It also presents an overview of Latin American relations with other parts of the world through the region's experiences with global culture, migration, imperialism, dependency, and entanglements with the United States. This course is especially appropriate for students who expect to complete their HUA, IQP, and/or MQP at WPI project centers in Latin America. No prior knowledge is expected.

Department

International and Global Studies

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

None.

INTL 2100 : Approaches to Global Studies

This course examines the major theoretical and methodological approaches that characterize global studies. Since the end of the Cold War, new forms of transnational integration, interdependence and conflict have been considered examples of globalization. Yet this period is not the first to undergo such transformation, and the "global" is often experienced in disparate ways around the world. This course examines the diverse ways of understanding globalization in the past and present. No prior background is required. Especially appropriate for students interested in any of WPI's global Project Centers.

Department

International and Global Studies

Category

Category I (offered at least 1x per Year)

Units 1/3

INTL 2110 : Global Justice

What is justice during an era of globalization? What are the rights and responsibilities of individuals, groups, nations, or supranational organizations in a world of profound inequalities of wealth or disparities of power? This course takes an interdisciplinary approach to historical, literary, religious, and ethical debates about global justice as well as the political and practical responses by various actors in the global South and North. Themes will vary each time the course is taught and may include globalization and distributive justice, climate justice, migration, citizenship, cosmopolitanism, human rights, ideology, reparations, racial or gender equity, nationalism and internationalism, and global democracy. No prior background required. This course will be offered in 2022-23, and in alternating years thereafter.

Department

International and Global Studies

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

None.

INTL 2210 : Popular Culture and Social Change in Asia

Godzilla, kung-fu, anime, sushi, Hello Kitty, yin and yang, Pokémon, manga. All of these have become part of our American lives, but where did they come from and what meaning do they hold as cultural phenomena? In this class we will explore the popular cultures of East Asia to better understand the influences that have shaped the region's contemporary societies. Focus country will be either Japan or China, depending on term offered. Students will study various media of popular culture, such as films, songs, advertisements, video games, manga, anime, to explore the changing society of these countries. We will link the individual cultural phenomena studied to both internal and external influences, situating popular culture within transnational currents and exchanges when appropriate. No prior knowledge of Asian history is required forth is class. This course will be offered in 2021-22, and in alternating years thereafter.
Students may not receive credit for HU 2340 and INTL 2210.

Department

International and Global Studies

Category

Category II (offered at least every other Year)

Units 1/3

INTL 2310 : Modern Latin America

This course uses interdisciplinary, thematic, and case study approaches in the examination of modern Latin America. It draws from the Latin America's diversity to explore topics in the past and present that are critical for students' development of a more advanced understanding of the region and its residents. The course may include the study of topics such as cultural production, nationalism, urban and rural development, migration, social and racial inequality, democracy, and social justice through the disciplines of history and global studies, literature and creative arts, social sciences, environmental studies, and others. Examples and case studies from the nineteenth, twentieth, and twenty-first centuries will be drawn especially from locations in Latin America where WPI maintains Global Project Centers. Students may not receive credit for both INTL 22IX and INTL 2310. This course will be offered in 2022-23 and in alternating years thereafter.

Department

International and Global Studies

Category

Category II (offered at least every other Year)

Units 1/3

INTL 2320 : Environmental Justice in the Global Caribbean and Latin America

Latin America and the Caribbean are center stage in discussions about the inequalities and injustices of our current global ecological crisis. This course offers a two-fold approach. 1) It examines historical and contemporary processes producing—and contesting—environmental injustices in Latin America and the Caribbean Basin. 2) It analyzes the role of this region in the politics and policy of global environmental inequalities, including the region's relationship with the United States, China, and other major international actors in issues such as climate change and sustainable development. This course is especially appropriate for students interested in environment and sustainability issues and international/global affairs, and for students who expect to complete their HUA, IQP, and/or MQP at WPI Project centers in Latin America or the Caribbean.

Department

International and Global Studies

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

None

INTL 2410 : Modern Africa

This interdisciplinary course takes a thematic approach to modern Africa. Topics and themes will vary each time the course is taught, and may include African kingdoms, the influence of Islam, the legacy of the Atlantic slave trade, imperialism and decolonization, democratization, the politics of language, or African literature and art. Examples and case studies will include locations where WPI has programs in this diverse and dynamic region. No prior background required. Students may not receive credit for both INTL 2410 and HU 2441. This course will be offered in 2021-22, and in alternating years thereafter.

Department

International and Global Studies

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

None.

INTL 2420 : Middle East, North Africa and Mediterranean

This interdisciplinary course takes a thematic approach to the Middle East, North Africa and Mediterranean region. Themes and topics will vary each time the course is taught, and may include religion and culture, national, ethnic and linguistic identities, the Mediterranean as a contact zone, U.S. political and economic involvement in the region, postcolonialism, war and conflict, migration, forced displacement and refugees, human rights, religious freedom, popular culture, the politics of Islam and secularism, the regional intersections of Judaism, Christianity, and Islam, representations of Islam and other religions in visual culture, gender and media, and the circulation of U.S. culture. Examples and case studies will include locations where WPI has programs in this diverse and dynamic region. No prior background required.

Department

International and Global Studies

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

None.

INTL 2510 : Contemporary Europe: Union and Disunion

This interdisciplinary course takes a thematic approach to contemporary Europe, especially since the establishment of European Union's single market and common currency. Topics and themes will vary each time the course is taught and may include expansion of the EU and Euro, the impact of the free movement of goods, capital, services and people, migration and refugees, populist and nationalist movements, uneven development between regions within Europe, postcolonial relations with other parts of the world, and debates over national heritage and cultural change. Examples and case studies will include locations where WPI has programs in Europe. No prior background is required. This course will be offered in 2022-23, and in alternating years thereafter.

Department

International and Global Studies

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

None.

INTL 2520 : Russia Ready: Language and Cultural Context

This course will introduce students to the fundamentals of Russian language, current events and culture. Students will be expected to steadily build essential vocabulary, learn basic grammar and forms of address; they will also review major events of Russian history from the rule of Peter the Great to the Russian Revolution and the Soviet era developments - all of which are key to understanding of Russia today. All through the course, students will have assigned media topics ranging from the student life in Russia, to aerospace exploration to agricultural breakthroughs and political turmoil. Materials under study will include Russian language textbooks and grammar guides, current media, and film. This course is appropriate for students interested in all WPI's project centers in Eastern and Central Europe. This course will be offered in on-line format. Students may not receive credit for HU 2230 or HU 223X and INTL 2520.

Department

International and Global Studies

Category

Category II (offered at least every other Year)

Units 1/6

INTL 2910 : Topics in Global Studies

This seminar course takes an interdisciplinary approach to historical and contemporary topics in global studies. Topics vary each year and may include international development, global inequality and justice, global public health, war and terrorism, international organizations and governance, humanitarianism and human rights, travel and tourism, the Anthropocene, climate change. No prior background is required. Especially appropriate for students interested in any of WPI's global Project Centers.

Department

International and Global Studies

Category

Category I (offered at least 1x per Year)

Units 1/3

INTL 3050 : Global Re-Entry Seminar

Global projects are often life-changing and many students want to make sense of their experience and deepen global learning after returning to campus. This course provides opportunities for self-reflection about global experiences, for connecting with peers to share stories, and for translating these experiences into skills and future professional opportunities, which may include internships, scholarships, post-graduate study or employment. Students completing this seminar will have reflected on their global experiences, articulated and identified transferable skills garnered while away, and integrated these reflections into future academic plans, personal aspirations, or career goals.

Department

International and Global Studies

Category

Category I (offered at least 1x per Year)

Units 1/6

Recommended Background

This course is intended for students who have participated in WPI's global programs, including global IQPs, MQPs, Humanities projects, or exchange programs, either in the US or abroad.

INTL 4100 : Senior Seminar in International and Global Studies

In this capstone seminar in International and Global Studies, students will reflect on what they learned in previous global experiences and critically analyze contemporary global issues. The seminar aims to develop habits of lifelong learning as students articulate strategies for translating global experiences and expertise into personal values and professional opportunities in their future careers.

Department

International and Global Studies

Category

Category I (offered at least 1x per Year)

Units 1/3

Mathematical Sciences

BCB 4004/MA 4603 : Statistical Methods in Genetics and Bioinformatics

This course provides students with knowledge and understanding of the applications of statistics in modern genetics and bioinformatics. The course generally covers population genetics, genetic epidemiology, and statistical models in bioinformatics. Specific topics include meiosis modeling, stochastic models for recombination, linkage and association studies (parametric vs. nonparametric models, family-based vs. population-based models) for mapping genes of qualitative and quantitative traits, gene expression data analysis, DNA and protein sequence analysis, and molecular evolution. Statistical approaches include log-likelihood ratio tests, score tests, generalized linear models, EM algorithm, Markov chain Monte Carlo, hidden Markov model, and classification and regression trees. This course will be offered in 2021-22, and in alternating years thereafter.

Department

Bioinformatics and Computational Biology
Mathematical Sciences

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

MA 2612, MA 2631 (or MA 2621), and BB 2920 or more biology courses.

CS 2022/MA 2201 : Discrete Mathematics

This course serves as an introduction to some of the more important concepts, techniques, and structures of discrete mathematics providing a bridge between computer science and mathematics. Topics include sets, functions and relations, propositional and predicate calculus, mathematical induction, properties of integers, counting techniques, and graph theory. Students will be expected to develop simple proofs for problems drawn primarily from computer science and applied mathematics.

Department

Computer Science
Mathematical Sciences

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

None.

CS 4032/MA 3257 : Numerical Methods for Linear and Nonlinear Systems

This course provides an introduction to modern computational methods for linear and nonlinear equations and systems and their applications. Topics covered include solution of nonlinear scalar equations, direct and iterative algorithms for the solution of systems of linear equations, solution of nonlinear systems, and the eigenvalue problem for matrices. Error analysis will be emphasized throughout.

Department

Computer Science
Mathematical Sciences

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

MA 2071. An ability to write computer programs in a scientific language is assumed.

CS 4033/MA 3457 : Numerical Methods for Calculus and Differential Equations

This course provides an introduction to modern computational methods for differential and integral calculus and differential equations. Topics covered include interpolation and polynomial approximation, approximation theory, numerical differentiation and integration, and numerical solutions of ordinary differential equations. Error analysis will be emphasized throughout.

Department

Computer Science
Mathematical Sciences

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

MA 2051. An ability to write computer programs in a scientific language is assumed. Undergraduate credit may not be earned for both this course and for MA 3255/CS 4031.

DS 4635/MA 4635 : Data Analytics and Statistical Learning

The focus of this class will be on statistical learning - the intersection of applied statistics and modeling techniques used to analyze and to make predictions and inferences from complex real-world data. Topics covered include: regression; classification/clustering; sampling methods (bootstrap and cross validation); and decision tree learning. Students may not receive credit for both MA 463X and MA 4635.

Department

Data Science
Mathematical Sciences

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Linear Algebra (MA 2071 or equivalent), Applied Statistics and Regression (MA 2612 or equivalent), Probability (MA 2631 or equivalent). The ability to write computer programs in a scientific language is assumed.

MA 1020 : Calculus I with Preliminary Topics

This course is a 14-week alternative to the 7-week MA 1021. This course offers 1/3 unit of credit. It is designed for students looking to develop essential skills in algebra and trigonometry or strengthen their mathematical background. It provides a review of selected topics from algebra, trigonometry, and analytic geometry, then continues on to provide an introduction to differentiation and its applications. Topics covered include: trigonometry, conic sections; functions, their graphs, and inverses; limits, continuity, and differentiation; linear approximation; chain rule; and applications of derivatives such as min/max problems. Although the course will make use of computers, no programming experience is assumed. Students may not receive credit for both MA 1020 and MA 1021.

Department

Mathematical Sciences

Units 1/3

MA 1021 : Calculus I

This course provides an introduction to differentiation and its applications. Topics covered include: functions and their graphs, limits, continuity, differentiation, linear approximation, chain rule, min/max problems, and applications of derivatives. Students may not receive credit for both MA 1021 and MA 1020.

Department

Mathematical Sciences

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Algebra, trigonometry and analytic geometry. Although the course will make use of computers, no programming experience is assumed.

MA 1022 : Calculus II

This course provides an introduction to integration and its applications. Topics covered include: inverse trigonometric functions, Riemann sums, fundamental theorem of calculus, basic techniques of integration, volumes of revolution, arc length, exponential and logarithmic functions, and *applications of integration to engineering*.

Department
Mathematical Sciences
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
MA 1020 or MA 1021. Although the course will make use of computers, no programming experience is assumed.

MA 1023 : Calculus III

This course provides an introduction to series, parametric curves and vector algebra. Topics covered include: numerical methods, indeterminate forms, improper integrals, sequences, Taylor's theorem with remainder, convergence of series and power series, polar coordinates, parametric curves and vector algebra.

Department
Mathematical Sciences
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
MA 1022. Although the course will make use of computers, no programming experience is assumed.

MA 1024 : Calculus IV

This course provides an introduction to multivariable calculus. Topics covered include: vector functions, partial derivatives and gradient, multivariable optimization, double and triple integrals, polar coordinates, other coordinate systems and applications.

Department
Mathematical Sciences
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
MA 1023. Although the course will make use of computers, no programming experience is assumed.

MA 1033 : Theoretical Calculus III

This course will cover the same material as MA 1023 Calculus III but from a different perspective. A more rigorous study of sequences and series will be undertaken: starting from the least upper bound property in R, the fundamental theorems for convergent series will be proved. Convergence criteria for series will be rigorously justified and L'Hospital's rule will be introduced and proved. Homework problems will include a blend of computational exercises as usually assigned in MA 1023 Calculus III and problems with a stronger theoretical flavor. Note: Students can receive credit for this class and MA 1023 Calculus III.

Department
Mathematical Sciences
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
Differential and integral calculus (MA 1021 and MA 1022, or equivalent).

MA 1034 : Theoretical Calculus IV

This course will cover the same material as MA 1024 Calculus IV from a more mathematically rigorous perspective. The course gives a rigorous introduction of differentiation and integration for functions of one variable. After introducing vector functions, differentiation and integration will be extended to functions of several variables. Note: Students can receive credit for this class and MA 1024 Calculus IV.

Department
Mathematical Sciences
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
Theoretical Calculus III (MA 1033, or equivalent).

MA 1120 : Calculus II (Semester Version)

This course is a 14-week alternative to the 7-week MA 1022. This course offers 1/3 unit of credit. It is designed for students who would benefit from additional contact hours and wish to strengthen their mathematical background. Topics covered include: inverse trigonometric functions, Riemann sums, fundamental theorem of calculus, basic techniques of integration, volumes of revolution, arc length, exponential and logarithmic functions, and applications of integration to engineering. The 14-week framework allows for an in-depth study of many of these topics as well as an introduction to some MA 1023 topics such as arithmetic and geometric sequences and series.

Department
Mathematical Sciences
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
MA 1020 or MA 1021. *Although the course will make use of computers, no programming experience is assumed. Students may not receive credit for both MA 1120 and MA 1022.*

MA 1801 : Denksport

Problem solving is a fundamental mathematical skill. In this course students will be exposed to problems coming from a wide range of mathematical disciplines; and will work together in a collaborative environment to explore potential solutions. Discussion problems may be inspired by the research of faculty leading the discussion, by past mathematical competitions (such as the Putnam Competition) or elsewhere. This course meets once per week, with an emphasis on discussion and exploration of problems. There will be no exam and no assigned homework. Grading is by participation only. This course may be taken multiple times; content will vary depending on the speakers. Grading for this course will be on a Pass/NR basis.

Department
Mathematical Sciences
Category
Category I (offered at least 1x per Year)
Units 1/12
Recommended Background
Curiosity about Mathematics

MA 1971 : Bridge to Higher Mathematics

The principal aim of this course is to practice mathematical problem interpretation, proof techniques, and question formulation. The course is intended not only for beginning students in the mathematical sciences, but also for all students interested in mathematical art and rigor. Students in the course will be expected to explain, justify, defend, disprove, conjecture and verify mathematical statements, both orally and in writing, in order to develop proof-writing skills. (These skills should prove useful in more advanced mathematics courses). Topics covered include basic logic; basic set theory; definitions and properties of functions; definitions and properties of binary relations; fundamental proof techniques, including proof by induction. Depending on student background and instructor preferences, the course objectives may be conveyed through a selection of problems from various mathematical sub-disciplines, through discussions of current events in the mathematical sciences, including recently solved problems and open challenges facing todays scientists, or through discussions of applications of mathematics.

Department

Mathematical Sciences

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

At least two courses in Mathematical Sciences at WPI, or equivalent.

MA 2051 : Ordinary Differential Equations

This course develops techniques for solving ordinary differential equations. Topics covered include: introduction to modeling using first-order differential equations, solution methods for linear higher-order equations, qualitative behavior of nonlinear first-order equations, oscillatory phenomena including spring-mass system and RLC-circuits and Laplace transform. Additional topics may be chosen from power series method, methods for solving systems of equations and numerical methods for solving ordinary differential equations.

Department

Mathematical Sciences

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

MA 1024.

MA 2071 : Matrices and Linear Algebra I

This course provides an introduction to the theory and techniques of matrix algebra and linear algebra. Topics covered include: operations on matrices, systems of linear equations, linear transformations, determinants, eigenvalues and eigenvectors, least squares, vector spaces, inner products, introduction to numerical techniques, and applications of linear algebra. Credit may not be earned for this course and MA 2072.

Department

Mathematical Sciences

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

None, although basic knowledge of equations for planes and lines in space would be helpful.

MA 2072 : Accelerated Matrices and Linear Algebra I

This course provides an accelerated introduction to the theory and techniques of matrix algebra and linear algebra, aimed at Mathematical Sciences majors and others interested in advanced concepts of linear algebra. Topics covered include: matrix algebra, systems of linear equations, linear transformations, determinants, eigenvalues and eigenvectors, the method of least squares, vector spaces, inner products, non-square matrices and singular value decompositions. Students will be exposed to computational and numerical techniques, and to applications of linear algebra, particularly to Data Science. Credit may not be earned for this course and MA 2071.

Department

Mathematical Sciences

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Basic knowledge of matrix algebra

MA 2073 : Matrices and Linear Algebra II

This course provides a deeper understanding of topics introduced in MA 2071, and continues the development of linear algebra. Topics covered include: abstract vector spaces, linear transformations, matrix representations of a linear transformation, determinants, characteristic and minimal polynomials, diagonalization, eigenvalues and eigenvectors, the matrix exponential, inner product spaces. This course is designed primarily for Mathematical Science majors and those interested in the deeper mathematical issues underlying linear algebra.

Department

Mathematical Sciences

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

MA 2071 or MA 2072.

MA 2210 : Mathematical Methods in Decision Making

This course introduces students to the principles of decision theory as applied to the planning, design and management of complex projects. It will be useful to students in all areas of engineering, actuarial mathematics as well as those in such interdisciplinary areas as environmental studies. It emphasizes quantitative, analytic approaches to decision making using the tools of applied mathematics, operations research, probability and computations. Topics covered include: the systems approach, mathematical modeling, optimization and decision analyses. Case studies from various areas of engineering or actuarial mathematics are used to illustrate applications of the materials covered in this course.

Department

Mathematical Sciences

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

MA 1024. Suggested background: Familiarity with vectors and matrices. Although the course makes use of computers, no programming experience is assumed. Students who have received credit for CE 2010 may not receive credit for MA 2210.

MA 2211 : Theory of Interest I

An introduction to actuarial mathematics is provided for those who may be interested in the actuarial profession. Topics usually included are: measurement of interest, including accumulated and present value factors; annuities certain; amortization schedules and sinking funds; and bonds.

Department

Mathematical Sciences

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Single variable calculus (MA 1021 and MA 1022 or equivalent) and the ability to work with appropriate computer software. Students may not receive credit for both MA 2211 and MA 3211

MA 2212 : Theory of Interest II

This course covers topics in fixed income securities. Topics are chosen to cover the mechanics and pricing of modern-day fixed income products and can include: yield curve theories; forward rates; interest rate swaps; credit-default swaps; bonds with credit risk and options; bond duration and convexity; bond portfolio construction; asset-backed securities, including collateralized debt obligations and mortgage-backed securities with prepayment risk; asset-liability hedging; applications of binomial interest rate trees.

Department
Mathematical Sciences
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
An introduction to theory of interest (MA 2211 or equivalent) and the ability to work with appropriate computer software.

MA 2251 : Vector and Tensor Calculus

This course provides an introduction to tensor and vector calculus, an essential tool for applied mathematicians, scientists, and engineers. Topics covered include: scalar and vector functions and fields, tensors, basic differential operations for vectors and tensors, line and surface integrals, change of variable theorem in integration, integral theorems of vector and tensor calculus. The theory will be illustrated by applications to areas such as electrostatics, theory of heat, electromagnetics, elasticity and fluid mechanics.

Department
Mathematical Sciences
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
MA 1024.

MA 2271 : Graph Theory

This course introduces the concepts and techniques of graph theory—a part of mathematics finding increasing application to diverse areas such as management, computer science and electrical engineering. Topics covered include: graphs and digraphs, paths and circuits, graph and digraph algorithms, trees, cliques, planarity, duality and colorability. This course is designed primarily for Mathematical Science majors and those interested in the deeper mathematical issues underlying graph theory. Undergraduate credit may not be earned both for this course and for MA 3271. This course will be offered in 2022-23, and in alternating years thereafter.

Department
Mathematical Sciences
Category
Category II (offered at least every other Year)
Units 1/3
Recommended Background
MA 2071.

MA 2273 : Combinatorics

This course introduces the concepts and techniques of combinatorics— a part of mathematics with applications in computer science and in the social, biological, and physical sciences. Emphasis will be given to problem solving. Topics will be selected from: basic counting methods, inclusion-exclusion principle, generating functions, recurrence relations, systems of distinct representatives, combinatorial designs, combinatorial algorithms and applications of combinatorics. This course is designed primarily for Mathematical Sciences majors and those interested in the deeper mathematical issues underlying combinatorics. Undergraduate credit may not be earned both for this course and for MA 3273. This course will be offered in 2021-22, and in alternating years thereafter.

Department
Mathematical Sciences
Category
Category II (offered at least every other Year)
Units 1/3
Recommended Background
MA 2071.

MA 2431 : Mathematical Modeling with Ordinary Differential Equations

This course focuses on the principles of building mathematical models from a physical, chemical or biological system and interpreting the results. Students will learn how to construct a mathematical model and will be able to interpret solutions of this model in terms of the context of the application. Mathematical topics focus on solving systems of ordinary differential equations, and may include the use of stability theory and phase-plane analysis. Applications will be chosen from electrical and mechanical oscillations, control theory, ecological or epidemiological models and reaction kinetics. This course is designed primarily for students interested in the deeper mathematical issues underlying mathematical modeling. Students may be required to use programming languages such as Matlab or Maple to further investigate different models.

Department

Mathematical Sciences

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

multivariable calculus (MA 1024 or equivalent), ordinary differential equations (MA 2051 or equivalent), and linear algebra (MA 2071 or equivalent).

MA 2610 : Applied Statistics for the Life Sciences

This course is designed to introduce the student to statistical methods and concepts commonly used in the life sciences. Emphasis will be on the practical aspects of statistical design and analysis with examples drawn exclusively from the life sciences, and students will collect and analyze data. Topics covered include analytic and graphical and numerical summary measures, probability models for sampling distributions, the central limit theorem, and one and two sample point and interval estimation, parametric and non-parametric hypothesis testing, principles of experimental design, comparisons of paired samples and categorical data analysis. Undergraduate credit may not be earned for both this course and for MA 2611.

Department

Mathematical Sciences

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

MA 1022.

MA 2611 : Applied Statistics I

This course is designed to introduce the student to data analytic and applied statistical methods commonly used in industrial and scientific applications as well as in course and project work at WPI. Emphasis will be on the practical aspects of statistics with students analyzing real data sets on an interactive computer package. Topics covered include analytic and graphical representation of data, exploratory data analysis, basic issues in the design and conduct of experimental and observational studies, the central limit theorem, one and two sample point and interval estimation and tests of hypotheses.

Department

Mathematical Sciences

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

MA 1022.

MA 2612 : Applied Statistics II

This course is a continuation of MA 2611. Topics covered include simple and multiple regression, one and two-way tables for categorical data, design and analysis of one factor experiments and distribution-free methods.

Department

Mathematical Sciences

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

MA 2611.

MA 2621 : Probability for Applications

This course is designed to introduce the student to probability. Topics to be covered are: basic probability theory including Bayes theorem; discrete and continuous random variables; special distributions including the Bernoulli, Binomial, Geometric, Poisson, Uniform, Normal, Exponential, Chi-square, Gamma, Weibull, and Beta distributions; multivariate distributions; conditional and marginal distributions; independence; expectation; transformations of univariate random variables.

Department
Mathematical Sciences
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
MA 1024.

MA 2631 : Probability Theory

The purpose of this course is twofold: • To introduce fundamental ideas and methods of mathematics using the study of probability as the vehicle. These ideas and methods may include systematic theorem-proof development starting with basic axioms; mathematical induction; set theory; applications of univariate and multivariate calculus. • To introduce the student to probability. Topics to be covered will be chosen from: axiomatic development of probability; independence; Bayes theorem; discrete and continuous random variables; expectation; special distributions including the binomial and normal; moment generating functions; multi-variate distributions; conditional and marginal distributions; independence of random variables; transformations of random variables; limit theorems. This course is designed primarily for Mathematical Sciences majors and those interested in the deeper mathematical issues underlying probability theory. A more applications-oriented course with similar content is MA 2621 Probability for Applications which is primarily designed for students in departments other than Mathematical Sciences. Undergraduate credit may not be earned both for this course and for MA 2621 Probability for Applications.

Department
Mathematical Sciences
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
Multivariable Differential and Integral Calculus (MA 1024, or equivalent).

MA 3212 : Actuarial Mathematics I

A study of actuarial mathematics with emphasis on the theory and application of contingency mathematics in various areas of insurance. Topics usually included are: survival functions and life tables; life insurance; property insurance; annuities; net premiums; and premium reserves.

Department
Mathematical Sciences
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
An introduction to the theory of interest, and familiarity with basic probability (MA 2211 and either MA 2621 or MA 2631, or equivalent).

MA 3213 : Actuarial Mathematics II

A continuation of the study of actuarial mathematics with emphasis on calculations in various areas of insurance, based on multiple insureds, multiple decrements, and multiple state models. Topics usually included are: survival functions; life insurance; property insurance; common shock; Poisson processes and their application to insurance settings; gross premiums; and reserves.

Department
Mathematical Sciences
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
An introduction to actuarial mathematics (MA 3212 or equivalent)

MA 3231 : Linear Programming

The mathematical subject of linear programming deals with those problems in optimal resource allocation which can be modeled by a linear profit (or cost) function together with feasibility constraints expressible as linear inequalities. Such problems arise regularly in many industries, ranging from manufacturing to transportation, from the design of livestock diets to the construction of investment portfolios. This course considers the formulation of such real-world optimization problems as linear programming problems, the most important algorithms for their solution, and techniques for their analysis. The core material includes problem formulation, the primal and dual simplex algorithms, and duality theory. Further topics may include: sensitivity analysis; applications such as matrix games or network flow models; bounded variable linear programs; interior point methods.

Department

Mathematical Sciences

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Matrices and Linear Algebra (MA 2071, or equivalent).

MA 3233 : Discrete Optimization

Discrete optimization is a lively field of applied mathematics in which techniques from combinatorics, linear programming, and the theory of algorithms are used to solve optimization problems over discrete structures, such as networks or graphs. The course will emphasize algorithmic solutions to general problems, their complexity, and their application to real-world problems drawn from such areas as VLSI design, telecommunications, airline crew scheduling, and product distribution. Topics will be selected from: Network flow, optimal matching, integrality of polyhedra, matroids, and NP-completeness. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Mathematical Sciences

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

At least one course in graph theory, combinatorics or optimization (e.g., MA 2271, MA 2273 or MA 3231).

MA 3457/CS 4033 : Numerical Methods for Calculus and Differential Equations

This course provides an introduction to modern computational methods for differential and integral calculus and differential equations. Topics covered include: interpolation and polynomial approximation, approximation theory, numerical differentiation and integration, numerical solutions of ordinary differential equations. Error analysis will be emphasized throughout.

Department

Mathematical Sciences

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

MA 2051. An ability to write computer programs in a scientific language is assumed. Undergraduate credit may not be earned for both this course and for MA 3255/CS 4031.

MA 3471 : Advanced Ordinary Differential Equations

The first part of the course will cover existence and uniqueness of solutions, continuous dependence of solutions on parameters and initial conditions, maximal interval of existence of solutions, Gronwall's inequality, linear systems and the variation of constants formula, Floquet theory, stability of linear and perturbed linear systems. The second part of the course will cover material selected by the instructor. Possible topics include: Introduction to dynamical systems, stability by Lyapunov's direct method, study of periodic solutions, singular perturbation theory and nonlinear oscillation theory. This course will be offered in 2021-22, and in alternating years thereafter.

Department

Mathematical Sciences

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

MA 2431 and MA 3832.

MA 3475 : Calculus of Variations

This course covers the calculus of variations and select topics from optimal control theory. The purpose of the course is to expose students to mathematical concepts and techniques needed to handle various problems of design encountered in many fields, e. g. electrical engineering, structural mechanics and manufacturing. Topics covered will include: derivation of the necessary conditions of a minimum for simple variational problems and problems with constraints, variational principles of mechanics and physics, direct methods of minimization of functions, Pontryagin's maximum principle in the theory of optimal control and elements of dynamic programming. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Mathematical Sciences

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

MA 2051.

MA 3627 : Introduction to the Design and Analysis of Experiments

This course will teach students how to design experiments in order to collect meaningful data for analysis and decision making. This course continues the exploration of statistics for scientific and industrial applications begun in MA 2611 and MA 2612. The course offers comprehensive coverage of the key elements of experimental design used by applied researchers to solve problems in the field, such as random assignment, replication, blocking, and confounding. Topics covered include the design and analysis of general factorial experiments; two-level factorial and fractional factorial experiments; principles of design; completely randomized designs and one-way analysis of variance (ANOVA); complete block designs and two-way analysis of variance; complete factorial experiments; fixed, random, and mixed models; split-plot designs; nested designs. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Mathematical Sciences

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

Applied Statistics (MA 2611 and MA2612, or equivalent).

MA 3631 : Mathematical Statistics

This course introduces students to the mathematical principles of statistics. Topics will be chosen from: Sampling distributions, limit theorems, point and interval estimation, sufficiency, completeness, efficiency, consistency; the Rao-Blackwell theorem and the Cramer-Rao bound; minimum variance unbiased estimators and maximum likelihood estimators; tests of hypotheses including the Neyman-Pearson lemma, uniformly most powerful and likelihood radio tests.

Department
Mathematical Sciences
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
MA 2631.

MA 3823 : Group Theory

This course provides an introduction to one of the major areas of modern algebra. Topics covered include: groups, subgroups, permutation groups, normal subgroups, factor groups, homomorphisms, isomorphisms and the fundamental homomorphism theorem.

Department
Mathematical Sciences
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
MA 2073.

MA 3825 : Rings and Fields

This course provides an introduction to one of the major areas of modern algebra. Topics covered include: rings, integral domains, ideals, quotient rings, ring homomorphisms, polynomial rings, polynomial factorization, extension fields and properties of finite fields. This course will be offered in 2021-22, and in alternating years thereafter.

Department
Mathematical Sciences
Category
Category II (offered at least every other Year)
Units 1/3
Recommended Background
MA 2073.

MA 3831 : Principles of Real Analysis I

Principles of Real Analysis is a two-part course giving a rigorous presentation of the important concepts of classical real analysis. Topics covered in the sequence include: basic set theory, elementary topology of Euclidean spaces, metric spaces, compactness, limits and continuity, differentiation, Riemann-Stieltjes integration, infinite series, sequences of functions, and topics in multivariate calculus.

Department
Mathematical Sciences
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
at least one course focused on proof-based mathematics (e.g., MA 1971 Bridge to Higher Mathematics, MA 1033 Theoretical Calculus III).

MA 3832 : Principles of Real Analysis II

MA 3832 is a continuation of MA 3831. For the contents of this course, see the description given for MA 3831.

Department

Mathematical Sciences

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

introductory knowledge in real analysis (e.g., MA 3831 Principles of Real Analysis I, or equivalent).

MA 4213 : Loss Models I - Risk Theory

This course covers topics in loss models and risk theory as it is applied, under specified assumptions, to insurance. Topics covered include: economics of insurance, short term individual risk models, single period and extended period collective loss models, and applications.

Department

Mathematical Sciences

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

An introduction to probability (MA 2631 or equivalent).

MA 4214 : Loss Models II - Survival Models

Survival models are statistical models of times to occurrence of some event. They are widely used in areas such as the life sciences and actuarial science (where they model such events as time to death, or to the development or recurrence of a disease), and engineering (where they model the reliability or useful life of products or processes). This course introduces the nature and properties of survival models, and considers techniques for estimation and testing of such models using realistic data. Topics covered will be chosen from: parametric and nonparametric survival models, censoring and truncation, nonparametric estimation (including confidence intervals and hypothesis testing) using right-, left-, and otherwise censored or truncated data.

Department

Mathematical Sciences

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

An introduction to mathematical statistics (MA 3631 or equivalent).

MA 4216 : Actuarial Seminar

This pass/fail graduation requirement will be offered every term, under the supervision of the actuarial professors. In order to receive a passing grade, students will need to complete some or all of the following: attend speaker talks, attend company visits to campus, take part and help out with Actuarial Club activities, prepare for actuarial exams, or complete other activities as approved by the instructor(s).

Department

Mathematical Sciences

Category

Category I (offered at least 1x per Year)

Recommended Background

Interest in being an actuarial mathematics major.

MA 4222 : Top Algorithms in Applied Mathematics

This course will introduce students to the top algorithms in applied mathematics. These algorithms have tremendous impact on the development and practice of modern science and engineering. Class discussions will focus on introducing students to the mathematical theory behind the algorithms as well as their applications. In particular, the course will address issues of computational efficiency, implementation, and error analysis. Algorithms to be considered may include the Krylov Subspace Methods, Fast Multipole Method, Monte Carlo Methods, Fast Fourier Transform, Kalman Filters and Singular Value Decomposition. Students will be expected to apply these algorithms to real-world problems; e.g., image processing and audio compression (Fast Fourier Transform), recommendation systems (Singular Value Decomposition), electromagnetics or fluid dynamics (Fast Multipole Method, Krylov Subspace Methods, and Fast Fourier Transform), and the tracking and prediction of an object's position (Kalman Filters). In addition to studying these algorithms, students will learn about high performance computing and will have access to a machine with parallel and GPU capabilities to run code for applications with large data sets. This course will be offered in 2021-22, and in alternating years thereafter.

Department

Mathematical Sciences

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

Familiarity with matrix algebra and systems of equations (MA 2071, MA 2072, or equivalent), numerical methods for the solution of linear systems or differential equations (MA 3257, MA 3457, or equivalent), and concepts from probability (MA 2621, MA 2631, or equivalent). The ability to write computer programs in a scientific language is assumed.

MA 4235 : Mathematical Optimization

This course explores theoretical conditions for the existence of solutions and effective computational procedures to find these solutions for optimization problems involving nonlinear functions. Topics covered include: classical optimization techniques, Lagrange multipliers and Kuhn-Tucker theory, duality in nonlinear programming, and algorithms for constrained and unconstrained problems. This course will be offered in 2021-22, and in alternating years thereafter.

Department

Mathematical Sciences

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

Vector calculus at the level of MA 2251.

MA 4237 : Probabilistic Methods in Operations Research

This course develops probabilistic methods useful to planners and decision makers in such areas as strategic planning, service facilities design, and failure of complex systems. Topics covered include: decisions theory, inventory theory, queuing theory, reliability theory, and simulation. This course will be offered in 2021-22, and in alternating years thereafter.

Department

Mathematical Sciences

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

Probability theory at the level of MA 2621 or MA 2631.

MA 4291 : Applied Complex Variables

This course provides an introduction to the ideas and techniques of complex analysis that are frequently used by scientists and engineers. The presentation will follow a middle ground between rigor and intuition. Topics covered include: complex numbers, analytic functions, Taylor and Laurent expansions, Cauchy integral theorem, residue theory, and conformal mappings.

Department

Mathematical Sciences

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

MA 1024 and MA 2051.

MA 4411 : Numerical Analysis of Differential Equations

This course is concerned with the development and analysis of numerical methods for differential equations. Topics covered include: well-posedness of initial value problems, analysis of Euler's method, local and global truncation error, Runge-Kutta methods, higher order equations and systems of equations, convergence and stability analysis of one-step methods, multistep methods, methods for stiff differential equations and absolute stability, introduction to methods for partial differential equations. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Mathematical Sciences

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

MA 2071 and MA 3457/CS 4033. An ability to write computer programs in a scientific language is assumed.

MA 4451 : Boundary Value Problems

Science and engineering majors often encounter partial differential equations in the study of heat flow, vibrations, electric circuits and similar areas. Solution techniques for these types of problems will be emphasized in this course. Topics covered include: derivation of partial differential equations as models of prototype problems in the areas mentioned above, Fourier Series, solution of linear partial differential equations by separation of variables, Fourier integrals and a study of Bessel functions.

Department

Mathematical Sciences

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

MA 1024 or and MA 2051.

MA 4473 : Partial Differential Equations

The first part of the course will cover the following topics: classification of partial differential equations, solving single first order equations by the method of characteristics, solutions of Laplace's and Poisson's equations including the construction of Green's function, solutions of the heat equation including the construction of the fundamental solution, maximum principles for elliptic and parabolic equations. For the second part of the course, the instructor may choose to expand on any one of the above topics. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Mathematical Sciences

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

MA 2251 and MA 3832.

MA 4631 : Probability and Mathematical Statistics I

(14 week course) Intended for advanced undergraduates and beginning graduate students in the mathematical sciences and for others intending to pursue the mathematical study of probability and statistics, this course begins by covering the material of MA 3613 at a more advanced level. Additional topics covered are: one-to-one and many-to-one transformations of random variables; sampling distributions; order statistics, limit theorems.

Department
Mathematical Sciences
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
MA 2631 or MA 3613, MA 3831, MA 3832.

MA 4632 : Probability and Mathematical Statistics II

(14 week course) This course is designed to complement MA 4631 and provide background in principles of statistics. Topics covered include: point and interval estimation; sufficiency, completeness, efficiency, consistency; the Rao-Blackwell theorem and the Cramer-Rao bound; minimum variance unbiased estimators, maximum likelihood estimators and Bayes estimators; tests of hypothesis including uniformly most powerful, likelihood ratio, minimax and bayesian tests.

Department
Mathematical Sciences
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
MA 3631 or MA 4631.

MA 4891 : Topics in Mathematics

Department
Mathematical Sciences
Category
Category I (offered at least 1x per Year)
Units 1/3

MA 4892 : Topics in Actuarial Mathematics

Topics covered in this course would vary from one offering to the next. The purpose of this course will be to introduce actuarial topics that typically arise in the professional actuarial organization's curriculum beyond the point where aspiring actuaries are still in college. Topics might include ratemaking, estimation of unpaid claims, equity linked insurance products, simulation, or stochastic modeling of insurance products. This course will be offered in 2022-23, and in alternating years thereafter.

Department
Mathematical Sciences
Category
Category II (offered at least every other Year)
Units 1/3
Recommended Background
Could vary by the specific topics being covered, but would typically include an introduction to the theory of interest and an introduction to actuarial mathematics (MA 2211 and MA 3212 or equivalent).

MA 4895 : Differential Geometry

The course gives an introduction to differential geometry with a focus on Riemannian geometry. Starting with the geometry of curves and surfaces in the three-dimensional Euclidean space and Riemannian metrics in 2 and higher dimensions, the course introduces the first fundamental form, tangent bundles, vector fields, distance functions and geodesics, followed by covariant derivatives and second fundamental form. The proof of Gauss's Theorema Egregium is highlighted. Additional topics are by instructor's discretion. Students may not receive credit for both MA 489X and MA 4895.

Department

Mathematical Sciences

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

Advanced Linear Algebra and Real Analysis (e.g., MA 2073 Theoretical Linear Algebra and MA 3831 Principles of Real Analysis, or equivalent)

Physics

PH 1110 : General Physics—Mechanics

Introductory course in Newtonian mechanics. Topics include: kinematics of motion, vectors, Newton's laws, friction, work-energy, impulse-momentum, for both translational and rotational motion. Students may not receive credit for both PH 1110 and PH 1111.

Department

Physics

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

concurrent study of MA 1021.

PH 1111 : Principles of Physics—Mechanics

An introductory course in Newtonian mechanics that stresses invariance principles and the associated conservation laws. Topics include: kinematics of motion, vectors and their application to physical problems, dynamics of particles and rigid bodies, energy and momentum conservation, rotational motion. Students may not receive credit for both PH 1111 and PH 1110.

Department

Physics

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

concurrent study of MA 1023 (or higher). Students with limited prior college-level calculus preparation are advised to take PH 1110.

PH 1120 : General Physics—Electricity and Magnetism

An introduction to the theory of electricity and magnetism. Topics include: Coulomb's law, electric and magnetic fields, capacitance, electrical current and resistance, and electromagnetic induction. Students may not receive credit for both PH 1120 and PH 1121.

Department

Physics

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

working knowledge of the material presented in PH 1110 or PH 1111 and concurrent study of MA 1022.

PH 1121 : Principles of Physics—Electricity and Magnetism

An introduction to electricity and magnetism, at a somewhat higher mathematical level than PH 1120. Topics include: Coulomb's Law, electric fields and potentials, capacitance, electric current and resistance, magnetism, and electromagnetic induction. Students may not receive credit for both PH 1121 and PH 1120.

Department

Physics

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

working knowledge of material covered in PH 1111 and concurrent study of MA 1024 (or higher). Students concurrently taking MA 1022 or MA 1023 are advised to take PH 1120.

PH 1130 : Modern Physics

An introduction to the pivotal ideas and developments of twentieth-century physics. Topics include: special relativity, photoelectric effect, X-rays, Compton scattering, blackbody radiation, DeBroglie waves, uncertainty principle, Bohr theory of the atom, atomic nuclei, radioactivity, and elementary particles.

Department

Physics

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

familiarity with material covered in PH 1110 and PH 1120 (or PH 1111 and PH 1121) and completion of MA 1021 and MA 1022.

PH 1140 : Oscillations and Waves

An introduction to oscillating systems and waves. Topics include: free, clamped forced, and coupled oscillations of physical systems, traveling waves and wave packets, reflection, and interference phenomena.

Department

Physics

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

working knowledge of the material covered in PH 1110 and PH 1120 (or PH 1111 and PH 1121) and completion of MA 1021, MA 1022 and MA 1023.

PH 1150 : Introductory Physics of Living Systems

This course introduces a selection of physics topics (Thermodynamics, Optics, Fluid
Dynamics, Waves, and Atomic and Nuclear Physics) that are critical to students pursuing degrees in Life Sciences, Pre-Med, and Pre-Health.

Department

Physics

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

General Physics -Mechanics (PH1110) or Principles of Physics -Mechanics (PH1111), General Physics
Electricity and Magnetism (PH1120) or Introductory Physics–Electricity and Magnetism (PH1121), completion or concurrent study of Calculus I (MA 1021) or Calculus II (MA1022)

PH 2101 : Principles of Thermodynamics

The course provides fundamental preparation for any specialized application of thermodynamics. The material covered includes a general description of large number systems, states, canonical state variables, state functions, response functions, and equations of state. Focus will be given to the physical meanings of free-energies, enthalpy, chemical potential, and entropy. Connections will be made to equilibrium states, reversible versus irreversible processes, phases and phase transformation, as well as the arrow of time as applied across disciplines.

Department
Physics
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
introductory mechanics and multi-variable calculus

PH 2201 : Intermediate Mechanics I

This course emphasizes a systematic approach to the mathematical formulation of mechanics problems and to the physical interpretation of the mathematical solutions. Topics covered include: Newton's laws of motion, kinematics and dynamics of a single particle, vector analysis, motion of particles, rigid body rotation about an axis.

Department
Physics
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
PH 1110, PH 1120, PH 1130, PH 1140, MA 1021, MA 1022, MA 1023, MA 1024 and concurrent registration in or completion of MA 2051.

PH 2202 : Intermediate Mechanics II

This course is a continuation of the treatment of mechanics started in PH 2201. Topics covered include: rigid-body dynamics, rotating coordinate systems, Newton's law of gravitation, central-force problem, driven harmonic oscillator, an introduction to generalized coordinates, and the Lagrangian and Hamiltonian formulation of mechanics.

Department
Physics
Category
Category I (offered at least 1x per Year)
Units 1/3

PH 2301 : Electromagnetic Fields

Introduction to the theory and application of electromagnetic fields, appropriate as a basis for further study in electromagnetism, optics, and solid-state physics. Topics: electric field produced by charge distributions, electrostatic potential, electrostatic energy, magnetic force and field produced by currents and by magnetic dipoles, introduction to Maxwell's equations and electromagnetic waves.

Department
Physics
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
introductory electricity and magnetism, vector algebra, integral theorems of vector calculus as covered in MA 2251.

PH 2501 : Photonics

An introduction to the use of optics for transmission and processing of information. The emphasis is on understanding principles underlying practical photonic devices. Topics include lasers, light emitting diodes, optical fiber communications, fiber lasers and fiber amplifiers, planar optical waveguides, light modulators and photodetectors. Recommended background is PH 1110, PH 1120, PH 1130 and PH 1140 (or their equivalents). This course will be offered in 2022-23, and in alternating years thereafter.

Department
Physics
Category
Category II (offered at least every other Year)
Units 1/3

PH 2502 : Lasers

An introduction to the physical principles underlying lasers and their applications. Topics will include the coherent nature of laser light, optical cavities, beam optics, atomic radiation, conditions for laser oscillation, optical amplifiers (including fiber amplifiers), pulsed lasers (Q switching and mode locking), laser excitation (optical and electrical), and selected laser applications. Recommended background is PH 1110, PH 1120, PH 1130 and PH 1140 (or their equivalents). This course will be offered in 2021-22, and in alternating years thereafter.

Department
Physics
Category
Category II (offered at least every other Year)
Units 1/3

PH 2510 : Atomic Force Microscopy

Atomic force microscopes (AFMs) are instruments that allow three-dimensional imaging of surfaces with nanometer resolution and are important enabling tools for nanoscience and technology. The student who successfully completes this course will understand the functional principles of AFMs, be able to run one, and interpret the data that are collected. This course will be offered in 2021-22, and in alternating years thereafter. Some sections of this course may be offered as Writing Intensive (WI).

Department
Physics
Category
Category II (offered at least every other Year)
Units 1/3
Recommended Background
PH 1110 and 1120.
Suggested
PH 1130 and PH 1140.

PH 2520 : Introduction to Astrophysics

A selective study of components of the universe (the solar system, stars, nebulae, galaxies) and of cosmology, based on astronomical observations analyzed and interpreted through the application of physical principles, and organized with the central purpose of presenting the latest understanding of the nature and evolution of the universe. Some topics to be covered include the Big Bang & Inflation; Stellar Behavior & Evolution; White Dwarfs, Neutron Stars, & Supernovae; Black Holes; Dark Matter & Dark Energy. This course will be offered in 2021-22, and in alternating years thereafter.

Department
Physics
Category
Category II (offered at least every other Year)
Units 1/3
Recommended Background
PH 1110 (or PH 1111), PH 1120 (or PH 1121), and especially PH 1130.
Suggested
PH 1140.

PH 2540 : Solar Systems

This course covers physics of the solar system and exo-planetary systems. Topics introduced will include the sun, moons and planets; the interplanetary space environment; gravitational interplay, planet atmospheres, surfaces and interiors; interplanetary travel, exploration and habitation; challenges of terraforming, comparison of planetary environments to Earth's biosphere; and the conditions required to support life. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Physics

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

a working knowledge of mechanics (PH 1110 or 1111), electrodynamics (PH 1120 or 1121), modern physics (PH 1130), and differential and integral calculus (MA 1021 and MA 1022).

PH 2550/AE 2550 : Atmospheric and Space Environments

This course introduces the ambient atmospheric and space environments encountered by aerospace vehicles. Topics include: the sun and solar activity; the solar wind; planetary magnetospheres; planetary atmospheres; radiation environments; galactic cosmic rays; meteoroids; and space debris.

Department

Physics

Aerospace Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

mechanics (PH 1110/1111 or equivalent), electromagnetism (PH 1120/1121 or equivalent), and ordinary differential equations (MA 2051 or equivalent).

PH 2601 : Photonics Laboratory

This course provides an experimental approach to concepts covered in Photonics (PH 2501), Lasers (PH 2502), and Optics (PH 3504). Through a series of individually tailored experiments, students will reinforce their knowledge in one or more of these areas, while at the same time gaining exposure to modern photonics laboratory equipment. Experiments available include properties of optical fibers, optical fiber diagnostics, optical communications systems, properties of photodetectors, mode structure and threshold behavior of lasers, coherence properties of laser light, characterization of fiber amplifiers, diffraction of light, polarization of light, interferometry. No prior laboratory background is expected. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Physics

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

PH 1110/1111, PH 1120/1121. PH 1130, PH 1140, and one or more of the courses PH 2501, PH 2502, or PH 3504.

PH 2651 : Intermediate Physics Laboratory

This course offers experience in experimentation and observation for students of the sciences and others. In a series of subject units, students learn or review the physical principles underlying the phenomena to be observed and the basis for the measurement techniques employed. Principles and uses of laboratory instruments including the cathode-ray oscilloscope, meters for frequency, time, electrical and other quantities are stressed. In addition to systematic measurement procedures and data recording, strong emphasis is placed on processing of the data, preparation and interpretation of graphical presentations, and analysis of precision and accuracy, including determination and interpretation of best value, measures of error and uncertainty, linear best fit to data, and identification of systematic and random errors. Preparation of high-quality experiment reports is also emphasized. Representative experiment subjects are: mechanical motions and vibrations; free and driven electrical oscillations; electric fields and potential; magnetic materials and fields; electron beam dynamics; optics; diffractiongrating spectroscopy; radioactive decay and nuclear energy measurements. Students who have received credit for PH 2600 or PH 3600 may not receive credit for PH 2651.

Department

Physics

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

the Introductory Physics course sequence or equivalent. No prior laboratory background beyond that experience is required.

PH 3206 : Statistical Physics

An introduction to the basic principles of thermodynamics and statistical physics. Topics covered include: basic ideas of probability theory, statistical description of systems of particles, thermodynamic laws, entropy, microcanonical and canonical ensembles, ideal and real gases, ensembles of weakly interacting spin 1/2 systems.

Department

Physics

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

knowledge of quantum mechanics and thermodynamics at the level of ES 3001.

PH 3301 : Electromagnetic Theory

A continuation of PH 2301, this course deals with more advanced subjects in electromagnetism, as well as study of basic subjects with a more advanced level of mathematical analysis. Fundamentals of electric and magnetic fields, dielectric and magnetic properties of matter, quasi-static time-dependent phenomena, and generation and propagation of electromagnetic waves are investigated from the point of view of the classical Maxwell's equations.

Department

Physics

Category

Category I (offered at least 1x per Year)

Units 1/3

PH 3401 : Quantum Mechanics I

This course includes a study of the basic postulates of quantum mechanics, its mathematical language and applications to one-dimensional problems. The course is recommended for physics majors and other students whose future work will involve the application of quantum mechanics. Topics include wave packets, the uncertainty principle, introduction to operator algebra, application of the Schroedinger equation to the simple harmonic oscillator, barrier penetration and potential wells.

Department

Physics

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Junior standing, MA 4451, and completion of the introductory physics sequence, including the introduction to the 20th century physics.

Suggested

knowledge (or concurrent study) of linear algebra, Fourier series, and Fourier transforms.

PH 3402 : Quantum Mechanics II

This course represents a continuation of PH 3401 and includes a study of three-dimensional systems and the application of quantum mechanics in selected fields. Topics include: the hydrogen atom, angular momentum, spin, perturbation theory and examples of the application of quantum mechanics in fields such as atomic and molecular physics, solid state physics, optics, and nuclear physics.

Department

Physics

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

PH 3401.

PH 3501 : Relativity

This course is designed to help the student acquire an understanding of the formalism and concepts of relativity as well as its application to physical problems. Topics include the Lorentz transformation, 4-vectors and tensors, covariance of the equations of physics, transformation of electromagnetic fields, particle kinematics and dynamics. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Physics

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

knowledge of mechanics and electrodynamics at the intermediate level.

PH 3502 : Solid State Physics

An introduction to solid state physics. Topics include: crystallography, lattice vibrations, electron band structure, metals, semiconductors, dielectric and magnetic properties. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Physics

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

prior knowledge of quantum mechanics at an intermediate level.

Suggested

knowledge of statistical physics is helpful.

PH 3503 : Nuclear Physics

This course is intended to acquaint the student with the measurable properties of nuclei and the principles necessary to perform these measurements. The major part of the course will be an introduction to the theory of nuclei. The principal topics will include binding energy, nuclear models and nuclear reactions. The deuteron will be discussed in detail and the nuclear shell model will be treated as well as the nuclear optical model. This course will be offered in 2021-22, and in alternating years thereafter.

Department

Physics

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

some knowledge of the phenomena of modern physics at the level of an introductory physics course and knowledge of intermediate level quantum mechanics.

PH 3504 : Optics

This course provides an introduction to classical physical optics, in particular interference, diffraction and polarization, and to the elementary theory of lenses. The theory covered will be applied in the analysis of one or more modern optical instruments. This course will be offered in 2021-22, and in alternating years thereafter.

Department

Physics

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

knowledge of introductory electricity and magnetism and of differential equations.

Suggested

PH 2301.

PH 4201/PH 511 : Advanced Classical Mechanics

A review of the basic principles and introduction to advanced methods of mechanics, emphasizing the relationship between dynamical symmetries and conserved quantities, as well as classical mechanics as a background to quantum mechanics. Topics include: Lagrangian mechanics and the variational principle, central force motion, theory of small oscillations, Hamiltonian mechanics, canonical transformations, Hamilton-Jacobi Theory, rigid body motion, and continuous systems. This is a 14-week course.

Department

Physics

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

PH 2201 and PH 2202.

Social Science & Policy Studies

ECON 3100 : Economics of Climate Change

The accumulation of carbon dioxide and other greenhouse gases such as methane are projected to increase global warming by 2 to 5 °C by the end of this century with impact on the environment, economy, and society. This course explores the economic causes and consequences of climate change and potential solutions to reduce its impacts. We will assess climate change policies in the U.S and globally and use economics tools to evaluate their costs and benefits and distributional effects between poor and rich countries.

Department

Economics

Social Science & Policy Studies

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

Introductory Microeconomics (ECON 1110)

ENV 3500 : Women and the Environment

This course examines the perceived, existing, and potential links between women and the environment with an emphasis on the roles of women in environmental movements, climate change, climate justice, forest conservation, water management, disaster recovery, womenperceptions of environmental risk, and other environmental issues. Through reading, discussion, documentary films and research project, we will explore how social, economic, political and cultural systems that shape women's environmental experiences and their resistance and strategies for social change.

Department

Civil, Environmental & Architectural Engineering

Social Science & Policy Studies

Category

Category II (offered at least every other Year)

Units 1/3

SOC 1500 : The Sociology of Race

This course introduces students to the sociology of race. The sociology of race examines how and why social, cultural, and historical forces combine to reproduce racism, racial discrimination, and racial inequality. What are the distinctions between race and ethnicity? What distinguishes, if at all, individual, institutional, structural, and cultural racism? What are racial formation, antiracism, pigmentocracy, and Whiteness? What role did W. E. B. Du Bois play in founding sociology in the US? Why has Du Bois and his theoretical contributions been erased from the history of sociology? What works best represent Du Bois's thoughts on the meaning of race and race relations? What is the relationship between Du Bois, the Atlanta School, and the sociology of race? To answer these questions, students will examine a range of primary, secondary, and tertiary texts and become familiar with the conceptual theories and research methods that inform the sociology of race and Du Bois's pioneering role in the field of sociology. Students will learn to think critically about the aims of the sociology of race and the theoretical means used to achieve those aims.

Department

Social Science & Policy Studies

Category

Category II (offered at least every other Year)

Units 1/3

Soc 3500 : African American Political Thought

This course introduces students to the oral and written discourse of African American political leaders. Ranging from the 1800s to the present, the course examines representations of African American political thought in the speeches and letters of African Americans who have held leadership positions in political organizations or who have participated in electoral politics. Students will explore the ideological foundations of the major African American political movements, examining how their goals and objectives have been informed by combinations of various political ideologies: Pan-Africanism, nationalism, feminism, radicalism, liberalism, centrism, and conservatism. What roles did African American leaders play in the Abolitionist movement? Who were the leaders of classical and modern Black nationalism? Who were the leaders of the Pan-African Congresses? What is the relationship between religiosity and African American political leadership? What are the similarities and differences between the strategies and tactics of the Abolitionist, New Negro, Civil Rights, Black Power, Black Arts, and Black Lives Matter movements? To answer these questions, students will examine a range of primary, secondary, and tertiary texts and become familiar with the conceptual theories and research methods that inform the study of African American political thought and intellectual history. Students will learn to think critically about the relationship between African American political thought, identity, and behavior.

Department

Social Science & Policy Studies

Category

Category II (offered at least every other Year)

Units 1/3

Social Science & Policy Studies Program

ENV1100 : Introduction to Environmental Studies

The study of environmental problems and their solutions requires an interdisciplinary approach. This course will examine current environmental issues from the intersection of several key disciplines including: environmental philosophy and history, environmental policy, and science. The course will develop these different approaches for analyzing environmental problems, explore the tensions between them, and present a framework for integrating them. Topics such as environmental justice, developing nations, globalization, and climate change policy will be explored.

Department

Social Science & Policy Studies Program

Category

Category I (offered at least 1x per Year)

Units 1/3

ENV 1100 : Introduction to Environmental Studies

Department

Social Science & Policy Studies Program

Units 1/3

ENV 1500 : Introduction to Geographical Information Systems

This course introduces Geographic Information Systems (GIS) as a powerful mapping and analytical tool. Topics include GIS data structure, map projections, and fundamental GIS techniques for spatial analysis. Laboratory exercises concentrate on applying concepts presented in lectures and will focus on developing skills using ArcGIS. These exercises include examples of GIS applications in environmental modeling, socio-demographic change and site suitability analyses. Although the course is computer-intensive, no programming background is required. Note: Students may not receive credit for both ENV 150X and ENV 1500. This course will be offered in 2021-22, and in alternating years thereafter.

Department

Social Science & Policy Studies Program

Category

Category II (offered at least every other Year)

Units 1/3

ENV 2200 : Environmental Studies in the Various Disciplines

Department
Social Science & Policy Studies Program
Units 1/3

ENV 2201 : Planning for Sustainable Communities

Sustainability planning seeks to anticipate and balance environmental, social, and economic impacts of human actions. This course presents an overview of how various perspectives can contribute to frameworks for environmental land use planning and management. Students are encouraged to think critically about problems land and natural resource use pose to society. Technical principles and analysis of sustainability planning are introduced and applied to challenges that communities currently face such as food, fiber and energy production, environmental conservation, hazard mitigation and resilience, water security, economic development, and waste management. Techniques to engage a diverse set of stakeholders in a collaborative planning process are examined along with the role of technology. This course will be offered in 2021-22, and in alternating years thereafter.
Department
Social Science & Policy Studies Program
Category
Category II (offered at least every other Year)
Units 1/3

ENV 2310 : Environmental Governance and Innovation

With global attention dominated by environmental catastrophe and despair, we will spotlight new work that has brought together scientists, environmentalists, engineers, and artists to tackle the most serious problems facing communities. We will explore the political ecology implications of control over essential resources and the positive consequences of rethinking and democratizing basic social needs for a more sustainable future. Recent exciting case studies will feature examples of simple solutions that inspire elegant, transferrable, and inexpensive applications of technological design. We will examine the role and obligation that scientists have to collaborate with interdisciplinary and public policy efforts that benefit people with sustainable approaches to architecture, food, energy, transportation, and infrastructure. Students may not receive credit for both ENV 230X and ENV 2310. This course will be offered in 2021-22, and in alternating years thereafter.
Department
Social Science & Policy Studies Program
Category
Category II (offered at least every other Year)
Units 1/3
Recommended Background
introductory environmental studies course

ENV 2500/PSY 2500 : Psychology for Sustainability

This course applies psychological theory and research to understand the causes of human behavior that degrades natural systems and to identify and promote more sustainable actions and policies. Topics will include: social dilemmas and cognitive limitations as root causes of environmental problems; psychological methods for studying sustainability; the potential for and limitations of changing individual environmental cognition and behavior; environmental knowledge, attitudes, and values; motivations for sustainable behavior; and the relationship between environmental quality and human health and mental health. Students will gain experience applying social and cognitive behavior change strategies to reduce their own environmental impact. Students may not receive credit for both ENV 2400 and ENV 2500/PSY 2500.
This course will be offered in 2021-22, and in alternating years thereafter.
Department
Social Science & Policy Studies Program
Psychology
Category
Category II (offered at least every other Year)
Units 1/3
Suggested
Introductory psychology and/or environmental studies.

ENV 2600 : Environmental Problems in the Developing World

Environment and development are often seen as incompatible, in part because many poor people in the developing world depend directly on natural resources for their livelihoods. At the same time, poor people are often seen as responsible for causing environmental degradation because they lack the knowledge, skills and resources to manage the environment effectively. The vicious circle is completed as environmental degradation exacerbates poverty. However, optimists argue that poor people can and do contribute positively to environmental outcomes, that states and organizations can facilitate their efforts and that environmental interventions can coincide with development. This course will examine these different perspectives on environmental problems in the developing world through the insights and critiques of social science. Subjects covered include sustainable development, population, environmental risks, gender, urbanization, environmental decision making, and non-governmental organizations (NGOs). The goals of this course are to think critically about the various links between environment and development and the role of governmental and non-governmental organizations in promoting sustainable development in the developing world. This course will be offered in 2021-22, and in alternating years thereafter.

Department

Social Science & Policy Studies Program

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

ENV 1100

ENV 2700 : Social Media, Social Movements, and the Environment

Social media platforms are changing the world of social movements, giving rise to a new generation of social activism. Social media can enable local actors to link with others from across the globe to incite social and environmental change. Social media has enabled people to document and share injustices (e.g., violence; dumping of toxic waste) in places where freedom of the press is limited or non-existent, and it has enabled people across different social groups (race, class, etc.) to engage with one another on issues of shared concern. Social media has also allowed people to share resources (financial, expertise, and organizational) with other social actors across the globe, empowering communities in novel ways. This course introduces students to the phenomena of social and environmental movements, theories on why they succeed and fail, and how social media has changed the landscape of social mobilization. This course will draw on interdisciplinary readings, concepts, and case studies from the social sciences, with emphasis on geography, public policy, sociology, and media studies. Course work will include small group projects, analyses of current social movement cases, and a final project. The final project will consist of interviewing members of a current social movement (potentially using social media), evaluating whether particular social media applications have helped to enable social mobilization, and designing new or revised social media tools to further enhance social mobilization.

Department

Social Science & Policy Studies Program

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

introductory environmental studies (ENV1100 or equivalent).

ENV 2710 : Designing for Climate Resilience and Justice

Resilience is the capacity to adapt to changing conditions and to bounce back after a disaster. Through resilience we can live, and even thrive, in the face of natural disasters. Resilience involves adaptation to the wide range of regional and localized impacts that are expected with a warming planet: more intense storms, greater precipitation, coastal and valley flooding, longer and more severe droughts in some areas, wildfires, melting permafrost, warmer temperatures, and power outages. Resilient design is the intentional design of buildings, landscapes, communities, and regions in response to these vulnerabilities. In this course, we will work to better understand what is at risk in a changing climate with more extreme and frequent disasters, the role people/companies and policies play in these disasters, who is most at risk and why, and develop resilient designs focused on practical, innovative, on-the-ground, and just solutions.
Students may not receive credit for both ENV 271X and ENV 2710
This course will be offered in 2021-22, and in alternating years thereafter.

Department
Social Science & Policy Studies Program
Category
Category II (offered at least every other Year)
Units 1/3
Recommended Background
None

ENV 2800 : Special Topics in Environmental and Sustainability Studies

(Credits will be assigned by the instructor ranging from 1/6-1/3 unit)
This course provides an opportunity for students with little to no background in Environmental and Sustainability Studies to learn about a special topic in the area. This course may be repeated for different topics.

Department
Social Science & Policy Studies Program
Category
Category III (offered at discretion of dept/prgm)

ENV 2900 : The Green Economy and Models for Alternative ForMS of Development

This course examines the limitations of traditional economic models and charts a new course for current policies and practices. To chart this path we draw upon and synthesize examples from existing alternative economies (e.g., different forms of dematerialization, hybrid organizations, solidary economy, sharing economy) .The course critically examines current paradigms of greening and seeks to expand thinking that will encompass new, alternative, and socially just conceptions of economy and economic development. A particular emphasis is laid on the spatial implications of de-growth oriented activities which partly challenge existing models and research methods in economic geography. This course will be offered in 2021-22, and in alternating years thereafter.

Department
Social Science & Policy Studies Program
Category
Category II (offered at least every other Year)
Units 1/3
Suggested
Basic knowledge of economics and environmental governance.

ENV 3100 : Adventures in Sustainable Urbanism

This course will take students on an adventure, both in the class and in the field. Students will examine the history of sustainable development, its antecedents, the factors that have influenced its evolution, and how the sustainable city came into existence. Students will be invited on a number of virtual field trips to sustainable cities from around the world. The goal will be to explore the underlying factors of sustainable urbanism, why it looks the way it does in different places, and how students can exercise their own agency in developing alternatives. Students will also develop their own field trips for publication on the course website. This course will be offered in 2021-22, and in alternating years thereafter.

Department

Social Science & Policy Studies Program

Category

Category II (offered at least every other Year)

Units 1/3

Suggested

introduction to environmental studies and a passion for urban exploration.

ENV 4400 : Senior Seminar in Environmental Studies

This course is intended for Environmental Studies majors. The course is designed to integrate each student's educational experience (e.g., core environmental courses, environmental electives, and environmental projects) in a capstone seminar in Environmental Studies. Through seminar discussions and writing assignments students will critically reflect on what they learned in their previous courses and project experiences. In teams, students will prepare a final capstone paper and presentation that critically engages their educational experience in environmental studies and anticipates how their courses and experiences will translate into their future personal and professional environmental experiences.

Department

Social Science & Policy Studies Program

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

ENV 1100, ENV 2200 or ENV 2400, completion or concurrent enrollment in IQP and MQP.

ENV 4800 : Special Topics in Environmental and Sustainability Studies

(Credits will be assigned by the instructor ranging from 1/6-1/3 unit)

This course provides an opportunity for students with a solid background and interest in Environmental and Sustainability Studies to learn about a special topic in the area. Recommended background: one 2000-level Environmental and Sustainability Studies courses (or equivalent). This course may be repeated for different topics.

Department

Social Science & Policy Studies Program

Category

Category III (offered at discretion of dept/prgm)

GOV 2319/ENV 2319 : Global Environmental Politics

It is apparent that environmental problems have outgrown national policy frameworks. Thus, institutions have emerged at the international and transnational levels to coordinate collective problem-solving. But governance involves more than just the practicality of problem-solving; it also involves uncertainty, controversy, power and politics. This course will examine the ways in which global environmental governance has been conceived: from establishing international institutions and agreements, to less tangible ways of interacting. We will examine themes such as scales of governance (from the United Nations to communities), policy networks, the role of NGOs, think tanks and special interests and the role of knowledge in global environmental debates. Students will then use this conceptual and theoretical basis to analyze major global environmental issues including: deforestation; biodiversity; endangered species; and climate change. The goals of this course are to gain an understanding of the main positions in global environmental debates; critically analyze these positions; and gain insight into the politics of global environmental policy and governance.

This course will be offered in 2021-22, and in alternating years thereafter.

Department

Political Science, Government and Law

Social Science & Policy Studies Program

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

None, but ENV 1100 would be helpful.

Development

DEV 1200 : International Development and Society

What is development? How has international development been understood and what has been done about it? How do development scholars explain why some countries are rich while others are poor? How can students understand and incorporate development studies in the contexts of their own global engagements? This course addresses these questions by looking at theories, ideologies, and processes that have influenced and embodied development thinking and practice over the past five decades. We will examine the role of colonization, modernization, dependency, globalization, democratization, industrialization, and urbanization in processes of development in countries across the globe. The course encourages students to think critically about what development is, about how it is carried out and, most importantly of all, about what it can achieve. DEV 1200 provides excellent preparation for international projects and careers.

Department

Development

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

None.

DEV 2200 : Case Studies in International Development Policy and Engineering

The engineers and scientists of tomorrow have a crucial role to play in discovering and implementing solutions to daunting international challenges related to food, water, energy, sanitation and infrastructure. The urgency of such challenges grows alongside and increasingly globalized workplace, where a growing number of graduates find themselves working outside the US, and invited to engage cultures, worldviews, value systems and physical environments that are very unlike their own. This course prepares students with global competency, to enable them to more effectively and ethically tackle problems in the context of starkly different socioeconomic, political, social and physical realities. Students will develop the knowledge, skills and understanding required to consider, accommodate and effectively integrate contextual difference into engineering practice by exploring the complexity of project design, the potential for unintended consequences, and how technologies are transformed in different contexts. This course will prepare students for a broad range of international IQP and MQPs. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Development

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

None.

DEV 4400 : Science, Engineering and Design in International Development

This course provides students with a set of skills that will allow them to address complex problems and design challenges in development engineering. Students will learn to participate in and lead innovation and creativity in collaborative settings. This course includes design projects and case studies, many related to projects at WPI. Student teams will work with preliminary data to define the problem. They will then collect and analyze interview and survey data to learn about user needs. Students will explore how to understand end-user needs. Students will use a variety of tools to analyze their data, ideate potential solutions, and prototype. The teams will use their projects to develop plans for rapid improvement, scaling, continuous improvement and a rigorous impact evaluation. This course will be offered in 2021-22, and in alternating years thereafter.

Department

Development

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

None.

Economics

ECON 1110 : Introductory Microeconomics

The course focuses upon the implications of reliance upon markets for the allocation of resources in a society, at the household, firm, and community level. Outcomes of current market systems are examined in terms of the efficient use of natural and other economic resources, as well as their impact upon the environment, fairness, and social welfare, of special interest in these analyses is the role of prices in the determination of what commodities are produced, their means of production, and distribution among households. In cases where current market outcomes have features subject to widespread criticism, such as the presence of excessive pollution, risk, discrimination, and poverty, the analysis is extended to suggest economic solutions. There are no prerequisites for the course.

Department

Economics

Category

Category I (offered at least 1x per Year)

Units 1/3

ECON 1120 : Introductory Macroeconomics

This course is designed to acquaint students with the ways in which macroeconomic variables such as national income, employment and the general level of prices are determined in an economic system. It also includes a study of how the techniques of monetary policy and fiscal policy attempt to achieve stability in the general price level and growth in national income and employment. The problems of achieving these national goals (simultaneously) are also analyzed. The course stresses economic issues in public policy and international trade.

Department
Economics
Category
Category I (offered at least 1x per Year)
Units 1/3

ECON 2110 : Intermediate Microeconomics

The topics addressed in this course are similar to those covered in ECON 1110 (Introductory Microeconomics) but the treatment proceeds in a more rigorous and theoretical fashion to provide a firm platform for students majoring in Economics or Business, or those having a strong interest in economics. Mathematics at a level comparable to that taught in MA 1021-MA 1024 is frequently applied to lend precision to the analysis. The course rigorously develops the microeconomic foundations of the theory of the firm, the theory of the consumer, the theory of markets, and the conditions required for efficiency in economic systems. This course will be offered in 2021-22, and in alternating years thereafter.

Department
Economics
Category
Category II (offered at least every other Year)
Units 1/3
Recommended Background
ECON 1110.

ECON 2120 : Intermediate Macroeconomics

This course is an advanced treatment of macroeconomic theory well suited for students majoring in Economics or Business, or others with a strong interest in economics. The topics addressed in ECON 2120 are similar to those covered in ECON 1120, however the presentation of the material will proceed in a more rigorous and theoretical fashion. This course will be offered in 2022-23, and in alternating years thereafter.

Department
Economics
Category
Category II (offered at least every other Year)
Units 1/3
Recommended Background
ECON 1110.

ECON 2126 : Public Economics

This course examines the economics of government expenditure and taxation. On the expenditure side, the course will review why governments often choose to be involved in the provision of healthcare, education, national defense, a clean environment, and infrastructure such as roads and bridges. It will also delve into the rationale behind programs such as social security. Regarding taxation, the course will cover income, consumption, and corporate taxes, including the use of corrective taxes to address market failures due to externalities. Within each topic, the relevant economic theories will be presented, and then students will practice applying the theories to real-world examples. As such, there will be plenty of opportunity to discuss policy implications and debate proposed policy changes. Students who completed ECON 212X: Public Economics cannot receive credit for ECON 2126: Public Economics.

Department
Economics
Category
Category II (offered at least every other Year)
Units 1/3
Recommended Background
Some introductory economics, such as Introductory Micro- or Macroeconomics (ECON 1110 or ECON 1120; or equivalent).

ECON 2130 : Econometric Modeling

Econometrics helps governments and businesses make more informed economic decisions. This course introduces the application of statistics and economic theory to formulating, estimating, and testing models about relationships among key variables. Topics include basic data analysis, regression analysis (including estimation, inference, assumptions, violations of assumptions, corrections for violations, dummy variables), and forecasting. Students will have the opportunity to use real-world socioeconomic data to test and interpret economic theories using econometric software. Successful students should also be able to formulate, estimate, and interpret their own testable relationships in other projects or fields of study.

Department

Economics

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

Some previous exposure to Economics, such as ECON 1110 and/or ECON 1120.

ECON 2135 : Information Economics and Policy

This course provides an introduction to the economics, business strategies, and regulatory and legal aspects of telecommunication markets. The analysis of complex interactions between technology, Federal and state government policies, copyright legislation, and forces driving supply and demand is performed using Economic and Industrial Organization theories combined with computer simulation techniques. Topics include, among others: the economics of telephony services, cable TV, satellite communication, spectrum auctions, WLAN, and peer-to-peer file sharing. Special attention will be paid to the analysis of the latest regulatory and legal developments in the telecommunications industry. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Economics

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

ECON 1110 or ECON 2110.

ECON 2145 : Behavioral Economics

Behavioral economics incorporates insights from psychology and sociology into economic models of decision-making. While traditional economic theory typically assumes individuals are self-interested and have an infinite ability to analyze and understand their decision-making environment, behavioral economics relaxes these assumptions in light of evidence from the field of experimental economics. Topics in the course include social preferences, mental accounting, decision-making under uncertainty and intertemporal choice. Additional topics may include the economics of social identity, preference formation and learning. Decision-making processes will be examined using simple economic experiments conducted in class.

Department

Economics

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

ECON 1110.

ECON 2155 : Experimental Economics

Experimental economics is a set of methods for testing hypotheses about behavior. Traditional economic analysis using naturally occurring data is often confounded by the complexities of the real world. Economic experiments, on the other hand, give researchers the control required for isolating behaviors of interest. As such, economic experiments can be useful tools for testing existing theories and establishing empirical regularities assisting in the development of new theories. In this course, we cover the basic principles of experimental design. We also study a number of classic experiments, on topics ranging from the efficiency of markets to decision-making under uncertainty and behavioral game theory. Students will participate in mock experiments and will begin putting their new skills into practice by designing their own experiments, which may serve as the basis for IQPs/MQPs. If time permits, we will discuss some of the basic methods for analyzing experimental data, which presents challenges somewhat different from naturally occurring data due to small sample sizes. This course will be offered in 2021-22, and in alternating years thereafter.

Department

Economics

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

ECON 1110

ECON 2910/ETR 2910 : Economics and Entrepreneurship

This course is designed to provide an introduction to economics, an introduction to entrepreneurship, and an understanding of the linkages between economics and entrepreneurship. Students will apply these concepts to the assessment of opportunities that might arise from participation in WPI projects. Students will engage in exploring how economics and entrepreneurship can inform opportunity assessment within an ambiguous and uncertain context. These decisions are always made with incomplete information and there is typically no single correct answer but rather multiple possible answers — each with pluses and minuses. Students may not earn credits for both ECON 2910/ETR 2910 and ECON 291X/ETR 29IX

Department

Economics

Entrepreneurship

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

None

ECON 3100 : Economics of Climate Change

The accumulation of carbon dioxide and other greenhouse gases such as methane are projected to increase global warming by 2 to 5 °C by the end of this century with impact on the environment, economy, and society. This course explores the economic causes and consequences of climate change and potential solutions to reduce its impacts. We will assess climate change policies in the U.S and globally and use economics tools to evaluate their costs and benefits and distributional effects between poor and rich countries.

Department

Economics

Social Science & Policy Studies

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

Introductory Microeconomics (ECON 1110)

ECON 3117 : Environmental Economics

This course investigates the effect of human activity upon the environment as well as the effect of the environment on human well-being. It pays special attention to the impact of production and consumption of material goods upon the quantity and quality of environmental goods. The analysis focuses on the challenges presented in mixed economics where markets are combined with government intervention to manage pollution and scarcity. The course reviews efforts to measure the costs and benefits of improving environmental conditions and evaluates current and potential policies in terms of the costs of the environmental improvements they may yield. Attention is also paid to the special difficulties which arise when the impacts of pollution spill across traditional political boundaries. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Economics

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

Introductory Microeconomics (Econ 1110)

Suggested

Students may not receive credit for both ECON 2117 and ECON 3117.

ECON 3125 : Development Economics

This course is a general introduction to the field of development economics. The focus is on ways in which a developing country can increase its productive capacity, both agricultural and industrial, in order to achieve sustained economic growth. The course proceeds by first examining how economic growth and economic development are measured and how the various nations of the world compare according to well-known social and economic indicators. Theories of economic growth and theories of economic development are then examined, as are the various social and cultural structures that are thought to influence economic progress. The inputs to economic growth and development (land, labor, capital, entrepreneurial ability, education, technical change), and the possible distributions of income and levels of employment that result from their use, is considered next. Domestic economic problems and policies such as development planning, the choice of sectorial policies, the choice of monetary and fiscal policies, rapid population growth, and urbanization and urban economic development are then examined. The course concludes with a consideration of international problems and policies such as import substitution and export promotion, foreign debt, foreign investment, and the role of international firms. In conjunction with a traditional presentation of the above topics, the course curriculum will include the use of computer simulation models and games. These materials have been formulated with a simulation technique, system dynamics, that has its origins in control engineering and the theory of servomechanisms. As a result, students will find them complementary to their work in engineering and science. In addition, the various development theories and simulation and gaming results will be related, where possible, to specific developing nations where WPI has on-going project activities (e.g., Costa Rica and Thailand). This course is recommended for those students wishing to do an IQP or MQP in a developing nation. This course will be offered in 2021-22, and in alternating years thereafter.

Department

Economics

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

Introductory Microeconomics (ECON 1110)

Suggested

Students may not receive credit for ECON 2125 and ECON 3125.

Political Science, Government and Law

GOV 1301 : U.S. Government

This course is an introduction to the fundamental principles, institutions, and processes of the constitutional democracy of the United States. It examines the formal structure of the Federal system of government, including Congress, the presidency, the judiciary, and the various departments, agencies, and commissions which comprise the executive branch. Emphasis is placed on the relationships among Federal, state and local governments in the formulation and administration of domestic policies, and on the interactions among interest groups, elected officials and the public at large with administrators in the policy process. The various topics covered in the survey are linked by consideration of fiscal and budgetary issues, executive management, legislative oversight, administrative discretion, policy analysis and evaluation and democratic accountability.

Department

Political Science, Government and Law

Category

Category I (offered at least 1x per Year)

Units 1/3

GOV 1303 : American Public Policy

American Public Policy focuses on the outcomes or products of political institutions and political controversy. The course first addresses the dynamics of policy formations and stalemate, the identification of policy goals, success and failure in implementation, and techniques of policy analysis. Students are then encouraged to apply these concepts in the study of a specific policy area of their choosing, such as foreign, social, urban, energy or environmental policy. This course is an important first step for students wishing to complete IQPs in public policy research. Students are encouraged to complete GOV 1303 prior to enrolling in upper level policy courses such as GOV 2303, GOV 2304 or GOV 2311. There is no specific preparation for this course, but a basic understanding of American political institutions is assumed. Some sections of this course may be offered as Writing Intensive (WI).

Department

Political Science, Government and Law

Category

Category I (offered at least 1x per Year)

Units 1/3

GOV 1310 : Law, Courts, and Politics

This course is an introduction to law and the role courts play in society. The course examines the structure of judicial systems, the nature of civil and criminal law, police practice in the enforcement of criminal law, and the responsibilities of judges, attorneys and prosecutors. Additional topics for discussion include the interpretation of precedent and statue in a common law system and how judicial discretion enables interest groups to use courts for social change. The student is expected to complete the course with an understanding of how courts exercise and thereby control the power of the state. As such, courts function as political actors in a complex system of governance. It is recommended that students complete this course before enrolling in GOV 2310, Constitutional Law. This course will be offered in 2021-22, and in alternating years thereafter.

Department

Political Science, Government and Law

Category

Category II (offered at least every other Year)

Units 1/3

GOV 1320 : Topics in International Politics

GOV 1320 is a survey course designed to introduce students to the basic concepts of international relations: power and influence, nations and states, sovereignty and law. These concepts will be explored through the study of issues such as diplomacy and its uses, theories of collective security and conflict, and international order and development. The study of international organizations such as the UN, the European Union or the Organization of American States will also supplement the students' understanding of the basic concepts. The course may also include comparative political analysis of states or regions. It is designed to provide the basic background materials for students who wish to complete IQPs on topics that involve international relations or comparative political systems. This course will be offered in 2021-22, and in alternating years thereafter.

Department

Political Science, Government and Law

Category

Category II (offered at least every other Year)

Units 1/3

GOV 2302 : Science-Technology Policy

This course is an examination of the relationship between science-technology and government. It reviews the history of public policy for science and technology, theories and opinions about the proper role of government and several current issues on the national political agenda. Examples of these issues include genetic engineering, the environment and engineering education. It also examines the formation of science policy, the politics of science and technology, the science bureaucracy, enduring controversies such as public participation in scientific debates, the most effective means for supporting research, and the regulation of technology. Throughout the course we will pay particular attention to the fundamental theme: the tension between government demands for accountability and the scientific community's commitment to autonomy and self-regulation. This course will be offered in 2021-22, and in alternating years thereafter.

Department

Political Science, Government and Law

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

GOV 1301 or GOV 1303.

GOV 2310 : Constitutional Law: Foundations of Government

Constitutional Law is the study of Supreme Court decisions interpreting the U.S. Constitution. The Foundations course focuses on the powers of the Congress, the Presidency and the Judicial Branch, especially the Supreme Court's understanding of its own power. These cases reveal, in particular, the evolution of Federal power with the development of a national economy and the shifting balance of power among the three branches of government. Issues of state power in a federal system are also addressed. Lastly, these materials are examined in the context of the great debates regarding how judges interpret the Constitution. How are the words and intent of the Founders applicable to the legal and political conflicts of the twenty-first century? This course will be offered in 2022-23, and in alternating years thereafter.

Department

Political Science, Government and Law

Category

Category II (offered at least every other Year)

Units 1/3

GOV 2311 : Environmental Policy and Law

This course deals with environmental law as it relates to people, pollution and land use in our society. A case method approach will be used to illustrate how the courts and legislators have dealt with these social-legal problems. The course is designed to have the student consider: 1) the legal framework within which environmental law operates; 2) the governmental institutions involved in the formulation, interpretation and application of environmental law; 3) the nature of the legal procedures and substantive principles currently being invoked to resolve environmental problems; 4) the types of hazards to the environment presently subject to legal constraints; 3) the impact that the mandates of environmental law have had, and will have, on personal liberties and property rights; 6) the role individuals and groups can play within the context of our legal system to protect and improve man's terrestrial habitat and the earth's atmosphere; and 7) some methods and sources for legal research that they may use on their own.

Department

Political Science, Government and Law

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

GOV 1303 or GOV 1310.

GOV 2313 : Intellectual Property Law

Intellectual property includes ideas, and the works of inventors, authors, composers and other creative people. Patents, copyrights and trademarks establish legal rights in intellectual property. Alternatively, control over the use of an idea might be maintained by treating it as a trade secret. In these ways, the ideas of inventors and creators are protected and others are prohibited from appropriating the ideas and creative works of others. This course addresses the concept of intellectual property and the public policies that support the law of patent, copyright and trademark. Subjects include the process of obtaining patents, trademarks and copyrights; requirements of originality and, for patents, utility; infringement issues; and the problems posed by international trade and efforts to address them through the World Intellectual Property Organization. This course will be offered in 2021-22, and in alternating years thereafter.

Department

Political Science, Government and Law

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

GOV 1310 or GOV 2310.

GOV 2314/ID 2314 : Cyberlaw and Policy

Rapidly developing technologies for computing, information management and communications have been quickly adopted in schools, businesses and homes. The growth of the Internet and of e-commerce, in particular, have given rise to an entirely new set of legal issues as the courts, Congress and international bodies struggle to keep pace with changing technology. This course addresses the government's role in the development of these technologies and the legal issues that result including questions regarding privacy rights, speech and defamation, and the application of patent and copyright law. Policy questions such as surveillance of e-mail, regulation of content, mandates on the use of filters, and the responsibilities and liability of internet service providers are also discussed. Additional policies studied include attempts to control Internet content and enforce international judgments (resulting from e-commerce or cyber-crime) by foreign states and/or international organizations. Students are expected to integrate knowledge of technology with law, politics, economics and international affairs. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Political Science, Government and Law

Integrative & Global Studies

Category

Category II (offered at least every other Year)

Units 1/3

GOV 2315 : Privacy: Laws, Policy, Technology, and How They Fit Together

This course will begin by examining privacy in different societies, starting with Eastern Europe during the Cold War and moving west. We will look first at privacy and the threats to it from government, then privacy and the threats posed by business. We will consider various technologies (including online social networks, communication Devices, the Internet), and different regimes for protecting privacy (including law, regulation, and technology). The course is designed to develop critical thinking about the interactions between technology, policy, and the law as well as learning about the privacy tradeoffs one makes in using modern technologies. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Political Science, Government and Law

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

GOV 1310 (Law, Courts, and Politics) or GOV 2310 (Constitutional Law).

GOV 2319/ENV 2319 : Global Environmental Politics

It is apparent that environmental problems have outgrown national policy frameworks. Thus, institutions have emerged at the international and transnational levels to coordinate collective problem-solving. But governance involves more than just the practicality of problem-solving; it also involves uncertainty, controversy, power and politics. This course will examine the ways in which global environmental governance has been conceived: from establishing international institutions and agreements, to less tangible ways of interacting. We will examine themes such as scales of governance (from the United Nations to communities), policy networks, the role of NGOs, think tanks and special interests and the role of knowledge in global environmental debates. Students will then use this conceptual and theoretical basis to analyze major global environmental issues including: deforestation; biodiversity; endangered species; and climate change. The goals of this course are to gain an understanding of the main positions in global environmental debates; critically analyze these positions; and gain insight into the politics of global environmental policy and governance.
This course will be offered in 2021-22, and in alternating years thereafter.

Department

Political Science, Government and Law
Social Science & Policy Studies Program

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

None, but ENV 1100 would be helpful.

GOV 2320 : Constitutional Law: Civil Rights and Liberties

Civil Rights and Liberties examines decisions of the Supreme Court which interpret the Bill of Rights and the Equal Protection Clause of the 14th Amendment. These court decisions elaborate the content and meaning of our rights to speak, publish, practice religion, and be free from state interference in those activities. Privacy rights broadly, the right to be free from unreasonable search and seizure, and due process rights for criminal suspects are also addressed. Finally, rights to be free from discrimination based on race, religion, ethnicity, gender and sexual orientation are examined in the context of equal protection law. Students completing this course will receive credit toward the Minor in Law and Technology among the courses satisfying the requirement in "legal fundamentals." This course will be offered in 2022-23, and in alternating years thereafter.

Department

Political Science, Government and Law

Category

Category II (offered at least every other Year)

Units 1/3

GOV 3000/PSY 3000 : Psychology and Law

How does the courtroom work and where does psychology come into play? Is it really "innocent until proven guilty"? Do people confess to crimes they never committed? How accurate are eyewitnesses? In this course, we will discuss and examine questions like these and many more. This course examines empirical research in the interface of psychology and law. We will learn about standard practices in the criminal justice system and empirical psychological research devoted to understanding these practices. As a discussion-based course, we will tackle topics such as: courtroom procedures, confessions, death penalty, deception, decision making, deliberations, eyewitnesses, expert testimony, jury selection, memory, police, and pretrial publicity. We will also explore how and when psychologists can impact legal guidelines and policies.
This course will be offered in 2021-22, and in alternating years thereafter.

Department
Political Science, Government and Law
Psychology
Category
Category II (offered at least every other Year)
Units 1/3
Recommended Background
Introduction to Psychological Science (PSY 1400), Social Psychology (PSY 1402) and/or Cognitive Psychology (PSY 1401). Courses in Government and Policy Studies will also be beneficial.

GOV 3312 : International Environmental Policy

Environmental issues present some of the major international problems and opportunities facing the world today. Worst-case scenarios envision irrevocable degradation of the earth's natural systems, but virtually every analysis sees the need for major change worldwide to cope with problems such as global warming, deforestation, ozone layer depletion, loss of biodiversity, and population growth, not to mention exponential increases in "conventional" pollutants in newly industrialized countries. The global environment issues represent a "second-generation" of environmental policy in which the focus of concern has moved from national regulations to international law and institutions. In addition, the environment has emerged as a major aspect of international trade, conditioning corporate investment and accounting for some $200 billion in sales of pollution control equipment in 1991. Exploration of the genesis and implications of these phenomena is the essence of the course. Topically, the material begins with the nature of global environmental problems, drawing on literature from large-scale global modeling as well as particular analyses of the problems mentioned above. Approximately half the course focuses on international laws and institutions, including multilateral treaties (e.g., the Montreal Protocol limiting CFC use, ocean dumping, biodiversity), international institutions (UNEP, the Rio Convention, the OECD) and private initiatives (international standards organizations, ICOLP (Industry Committee for Ozone Layer Protection), etc.) In addition, US policy toward global environmental issues will be compared with that in Japan, Europe and developing countries, from which it differs significantly. Students will design and undertake term projects that address particular issues in detail in an interdisciplinary manner. This course will be offered in 2021-22, and in alternating years thereafter.

Department
Political Science, Government and Law
Category
Category II (offered at least every other Year)
Units 1/3
Suggested
Students may not receive credit for GOV2312 and GOV 3312.

Psychology

ENV 2500/PSY 2500 : Psychology for Sustainability

This course applies psychological theory and research to understand the causes of human behavior that degrades natural systems and to identify and promote more sustainable actions and policies. Topics will include: social dilemmas and cognitive limitations as root causes of environmental problems; psychological methods for studying sustainability; the potential for and limitations of changing individual environmental cognition and behavior; environmental knowledge, attitudes, and values; motivations for sustainable behavior; and the relationship between environmental quality and human health and mental health. Students will gain experience applying social and cognitive behavior change strategies to reduce their own environmental impact. Students may not receive credit for both ENV 2400 and ENV 2500/PSY 2500.
This course will be offered in 2021-22, and in alternating years thereafter.
Department
Social Science & Policy Studies Program
Psychology
Category
Category II (offered at least every other Year)
Units 1/3
Suggested
Introductory psychology and/or environmental studies.

GOV 3000/PSY 3000 : Psychology and Law

How does the courtroom work and where does psychology come into play? Is it really "innocent until proven guilty"? Do people confess to crimes they never committed? How accurate are eyewitnesses? In this course, we will discuss and examine questions like these and many more. This course examines empirical research in the interface of psychology and law. We will learn about standard practices in the criminal justice system and empirical psychological research devoted to understanding these practices. As a discussion-based course, we will tackle topics such as: courtroom procedures, confessions, death penalty, deception, decision making, deliberations, eyewitnesses, expert testimony, jury selection, memory, police, and pretrial publicity. We will also explore how and when psychologists can impact legal guidelines and policies.
This course will be offered in 2021-22, and in alternating years thereafter.
Department
Political Science, Government and Law
Psychology
Category
Category II (offered at least every other Year)
Units 1/3
Recommended Background
Introduction to Psychological Science (PSY 1400), Social Psychology (PSY 1402) and/or Cognitive Psychology (PSY 1401). Courses in Government and Policy Studies will also be beneficial.

MU 2501/PSY 2501 : Music and Mind

How are we able to distinguish instruments, timbres and rhythms from the intertwined sonic stream presented by the world? How do we organize these elements in time to create rhythms, melodies, phrases and pieces? How do perception and memory interact to allow us navigate a musical work? We will explore these questions by considering the cognitive and perceptual processes that shape our musical experience. Topics will include event distinction, temporal perception, hierarchical organization, perceptual grouping, expertise, memory and categorization. We will illustrate these ideas in musical contexts by listening to a variety of musical works. We will consider how psychological principles are applied to music technologies, such as compression algorithms, mixing methodologies and the field of music information retrieval. We will consider experiments that focus on some of these topics to further our understanding about how we experience music. Note: Students that received credit for MU 202X may not receive credit for MU 2501. Students also may not receive credit for both MU 2501 and PSY 2501. This course can count for either the HUA or the SSPS requirement, but it cannot double count for both the HUA and SSPS graduation requirements.

Department

Music

Psychology

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Fundamentals of Music I and/or Fundamentals of Music II

PSY 1400 : Introduction to Psychological Science

Psychological science is the experimental study of human thought and behavior. Its goal is to contribute to human welfare by developing an understanding of why people do what they do. Experimental psychologists study the entire range of human experience, from infancy until death, from the most abnormal behavior to the most mundane, from the behavior of neurons to the actions of nations. This course offers a broad introduction to important theories, empirical findings, and applications of research in psychological science. Topics will include: use of the scientific method in psychology, evolutionary psychology, behavioral genetics, the anatomy and function of the brain and nervous system, learning, sensation and perception, memory, consciousness, language, intelligence and thinking, life-span development, social cognition and behavior, motivation and emotion, and the nature and treatment of psychological disorders.

Department

Psychology

Category

Category I (offered at least 1x per Year)

Units 1/3

PSY 1401 : Cognitive Psychology

This course is concerned with understanding and explaining the mental processes and strategies underlying human behavior. The ways in which sensory input is transformed, reduced, elaborated, stored, and recovered will be examined in order to develop a picture of the human mind as an active processor of information. Topics will include perception, memory, problem-solving, judgment and decision making, human-computer interaction, and artificial intelligence. Special attention will be paid to defining the limitations of the human cognitive system. Students will undertake a project which employs one of the experimental techniques of cognitive psychology to collect and analyze data on a topic of their own choosing.

Department

Psychology

Category

Category I (offered at least 1x per Year)

Units 1/3

Suggested

PSY 1400.

PSY 1402 : Social Psychology

Social psychology is concerned with how people think about, feel for, and act toward other people. Social psychologists study how people interact by focusing on the individual (not society as a whole) as the unit of analysis, by emphasizing the effect on the individual of the situation or circumstances in which behavior occurs, and by acquiring knowledge through empirical scientific investigation. This course will examine the cause of human behavior in a variety of domains of social life. Topics will include, but not be limited to, person perception, attitude formation and change, interpersonal attraction, stereotyping and prejudice, and small group behavior. Special attention will be given to applied topics: How can the research methods of social psychology be used to help solve social problems? Students will work together in small groups to explore in depth topics in social psychology of their own choosing.

Department

Psychology

Category

Category I (offered at least 1x per Year)

Units 1/3

Suggested

PSY 1400.

PSY 1404 : Developmental Psychology

This course surveys human development from conception to death, with an emphasis on the scientific analysis of developmental patterns. The course will cover the biological, cognitive, emotional, social, personality, linguistic, and moral development of the individual at all stages. Students may not receive credit for PSY140X and PSY 1404. Students may not receive credit for both PSY 140X and PSY 1404. Some sections of this course may be offered as Writing Intensive (WI).

Department

Psychology

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

An introductory background in psychological science or experimental methods (PSY 1400).

PSY 1412 : Mental Health

This course will introduce the wide variety of psychological disorders that exist in society (personality, anxiety, mood, psychotic, etc.). For each disorder discussed, possible causes, symptoms, preventions, and treatments will be examined. The course will cover psychopathologies throughout the entire spectrum of the lifespan (infancy to adulthood). Empirical research on understanding, diagnosing, and treating the different disorders will be emphasized.

Department

Psychology

Category

Category II (offered at least every other Year)

Units 1/3

Suggested

Introductory psychology (PSY 1400 or equivalent). Students may not receive credit for both PSY 1412 and PSY 14lX.

PSY 1504 : Strategies for Improving Cognitive Skills

Life experience provides us with little insight into the basic workings of our own minds. As a result, we tend to approach many of the important problems and decisions of our professional and personal lives with only a dim awareness of the limitations and capabilities of the human cognitive system and how its performance can be improved. The purpose of this course is (1) to provide students with the basic psychological knowledge needed to understand and evaluate such important cognitive skills as memory, problem solving, decision making, and reasoning and (2) to provide students the practical skills and experience necessary to improve and assess their cognitive performance. Topics will include but not be limited to memory improvement, study skills, effective problem solving techniques, creativity, numeracy, making effective choices, risky decision making, dynamic decision making, intelligent criticism of assumptions and arguments, and evaluating claims about the mind.

Department

Psychology

Category

Category I (offered at least 1x per Year)

Units 1/3

Suggested

PSY 1400.

PSY 1800 : Special Topics in Psychological Science

This course provides an opportunity for students with little to no background in psychological science to learn about a special topic within Psychological Science. This course may be repeated for different topics.

Department

Psychology

Category

Category III (offered at discretion of dept/prgm)

PSY 2401 : The Psychology of Education

This course is concerned with the learning of persons in educational settings from pre-school through college. Material in the course will be organized into five units covering a wide range of topics: Unit 1: Understanding Student Characteristics - Cognitive, Personality, Social, and Moral Development; Unit 2: Understanding the Learning Process - Behavioral, Humanistic, and Cognitive Theories of Learning; Unit 3: Understanding Motivation to Learn; Unit 4: Understanding Student Diversity - Cultural, Economic, and Gender Effects upon Learning; Unit 5: Evaluating Student Learning - Standardized Tests, Intelligence, Grades, and other Assessment Issues. Students planning IQPs in educational settings will find this course particularly useful. Instructional methods will include: lecture, discussion, demonstration, and project work. Course will also focus on current issues in technological education and international higher education. This course will be offered in 2021-22, and in alternating years thereafter.

Department

Psychology

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

PSY 1400 or PSY 1401.

PSY 2406 : Cross-Cultural Psychology: Human Behavior in Global Perspective

This course is an introduction to the study of the ways in which social and cultural forces shape human behavior. Cross-Cultural psychology takes a global perspective of human behavior that acknowledges both the uniqueness and interdependence of peoples of the world. Traditional topics of psychology (learning, cognition, personality development) as well as topics central to social psychology, such as intergroup relations and the impact of changing cultural settings, will be explored. Cultural influences on technology development and transfer, as they relate to and impact upon individual behavior, will also be investigated. Students preparing to work at international project centers, International Scholars, and students interested in the global aspects of science and technology will find the material presented in this course especially useful. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Psychology

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

PSY 1400 or PSY 1402.

PSY 2407 : Psychology of Gender

This course will provide an overview of the psychological study of gender and will utilize psychological research and theory to examine the influence of gender on the lives of men and women. This course will examine questions such as: What does it mean to be male or female in our society and other societies? How do our constructs of gender develop over our life span? How does our social world (e.g., culture, religion, media) play a role in our construction of gender? and What are the psychological and behavioral differences and similarities between men and women? This course will be offered in 2021-22, and in alternating years thereafter.

Department

Psychology

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

PSY 1400 or PSY 1402.

PSY 2408 : Health Psychology

In h ealth psychology, we will review global and domestic health-related problems to discuss the links between health and psychology and discuss potential interventions. Health psychology is interdisciplinary in nature and relevant to students interested in health-related topics whether from a psychological, biological, biomedical, global, or preventative measures. Major health problems will be discussed: for example, AIDS is the number one cause of death worldwide; obesity (in children and adults) is a growing epidemic; the aging U.S. population will cause unprecedented health needs. Finally, stress infiltrates chronic health outcomes such as cancer, diabetes, and cardiovascular disease. We will also review what positive health' means including nutrition, exercise, social support, managing stress, and habits for maintaining good health. Students will engage in research-based learning when considering psychological, cultural, and biological interventions for real world health crises.

Department

Psychology

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

Introduction to Psychological Science (PSY 1400) and/or Social Psychology (PSY 1402).

PSY 2410 : School Psychology

School psychology focuses on understanding children and adolescents' mental health, behavioral health and learning needs in order to work with educators and parents to help students succeed academically and socially. This course will provide an overview of the field of school psychology, drawing from educational, developmental, and cognitive research. Students will critically examine the theoretical, methodological, and practical approaches to understanding how in and out of school interventions and contexts influence the academic, social, and emotional development of children. Topics will include school readiness and transitions, behavioral and self-regulatory skills, socio-cultural diversity and skill gaps, assessment tools and classification, teacher-child interactions, and school- based interventions that promote positive development. This course differs from PSY 2401: They Psychology of Education in that it focuses on school systems rather than education more broadly. Students planning IQPs in educational settings will find this course particularly useful.

Department

Psychology

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

Introduction to Psychological Science (PSY 1400), Cognitive Psychology (PSY 1401), and/or The Psychology of Education (PSY 2401), or an approved equivalent.

PSY 2504 : Human Sexuality

Do women have less sexual arousal than men? How do religion, laws, and public policies influence perceptions of sex? What effects does pornography have on sexual attitudes and behaviors? How widespread is sexual and domestic violence? In this class, we will explore questions relating to our sexuality. Human sexuality is the study of the biological, evolutionary, social, cultural, and political perspectives relating to sex and the meaning behind "masculinity", "femininity", and "asexual" or "genderqueer". We will discuss topics such as: gender roles, transgender, sexual orientation, the anatomy and physiology of the act of sex, relationships, sexual aggression, pornography, contraception, pregnancy, abortion, sexuality and aging, and the role of religion, law, policies, and cultural. We will think about how our sexuality influences how we think and act in the world around us. We will examine sexuality within the United States and throughout the world. This course is designed to increase awareness and sensitivity to sexuality and issues relating to it. Discussions in class will be candid and on sensitive and controversial topics.

Department

Psychology

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

Introduction to Psychological Science (PSY 1400), Social Psychology (PSY 1402), and/or Psychology of Gender (PSY 2407).

PSY 2800 : Special Topics in Psychological Science

This course provides an opportunity for students with some background and interest in psychological science to learn about a special topic within Psychological Science. This course may be repeated for different topics.

Department

Psychology

Category

Category III (offered at discretion of dept/prgm)

Recommended Background

An introductory background in psychological science (PSY 1400, PSY1401, PSY 1402, or equivalent).

PSY 2900 : Introduction to Research in Psychological Science

This course provides an opportunity for students learn how to conduct psychological research in a research laboratory in psychological sciences. This course may be repeated for credit.

Department

Psychology

Units 0/6

Recommended Background

a base understanding of Psychological Science (PSY 1400, PSY 1401, PSY 1402, or equivalent). Permission of the instructor is necessary to register.

PSY 3400 : Survey Design and Methodology

Surveys are everywhere. But good surveys based on sound social science are rare. Conducting a successful survey requires familiarity with the methods and techniques developed by psychologists and other social scientists through long experience to ensure the accuracy, reliability, and validity of survey data. This course will focus on the common mistakes of first time survey researchers and ways to avoid them. Topics covered will include alternatives to survey research, sampling, response rates, questionnaire design and implementation, question wording, pretesting, ethical issues in survey research, and communicating survey results. Special attention will be given to issues related to the use of on-line survey platforms. During the course students will be guided through the development, implementation, and analysis of a survey on a topic of their own choosing.

This course is an appropriate methodology course for psychology and other social science majors and can also be taken by students of all majors as preparation for a survey-based IQP or MQP.

Students who completed PSY 340X cannot receive credit for PSY 3400.

This course will be offered in 2022-23 and in alternate years thereafter.

Department

Psychology

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

Introduction to Psychological Science (PSY 1400), Social Psychology (PSY 1402), or Cognitive Psychology (PSY 1401).

PSY 3500 : Experimental Design and Analysis

In this course, students will learn about different processes used when designing experiments. In addition, they will learn about different analyses that can be used based on different experimental designs. Students will design and run a simple experiment in the course. In addition, students will analyze the data and present their findings. Topics covered in the course include experimental design, experimental methods, ethical issues related to human participants research, use of statistical analyses and programs to analyze data, and hypothesis testing. Students may not receive credit for both SS 2400 and PSY 3500. This course will be offered in 2021-22 and in alternate years thereafter.

Department

Psychology

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

Familiarity with the fundamentals of psychological science and cognitive or social psychology (PSY 1400 and PSY 1401 or PSY 1402, or equivalent).

PSY 3800 : Special Topics in Psychological Science

This course provides an opportunity for students with a solid background and interest in psychological science to learn about a special topic within Psychological Science. This course may be repeated for different topics.

Department

Psychology

Category

Category III (offered at discretion of dept/prgm)

Recommended Background

one 2000-level Psychological Science courses (or equivalent).

PSY 3900 : Research in Psychological Science

This course provides an opportunity for students to conduct psychological research in a research laboratory in psychological sciences. This course may be repeated for credit.

Department

Psychology

Units 0/6

Recommended Background

a fundamental understanding of psychological science research (PSY 2900, PSY 3500, or equivalent). Permission of the instructor is necessary to register.

PSY 4110 : Psychophysiology

The field of Psychophysiology seeks to answer two key questions: (1) How do psychological factors – like our feelings, attitudes, relationships, behaviors, and social environments – get "under the skin" to affect our physiology? (2) How can we infer someone's psychological state based on a physiological measurement? For instance, how do different stimuli affect our heart rate? And in turn, if someone's heart is beating faster, might we infer that they are nervous or that they are excited? In this course, we will cover fundamental stress physiology (e.g., the nervous system, neuroendocrinology, the immunity system etc.), advanced methodologies for assessing psychophysiological constructs (e.g., electromyography, neuroimaging, biospecimens), and both foundational and emerging findings from the field. Ultimately, this course will teach students to make strong inferences about the links between the psychological experience and the body's physiological reactivity and to understand the broader implications of these links.
Note: Students may not receive credit for both PSY2502 and PSY4110.
This course will be offered in 2021-22 and in alternate years thereafter.

Department
Psychology
Category
Category II (offered at least every other Year)
Units 1/3
Recommended Background
PSY 1402: Social Psychology and/or PSY 2408: Health Psychology.

PSY 4800 : Special Topics in Psychological Science

This course provides an opportunity for students with a strong background and interest in psychological science to learn about a special topic within Psychological Science. This course may be repeated for different topics.
Department
Psychology
Category
Category III (offered at discretion of dept/prgm)
Recommended Background
two 2000 and/or 3000 level Psychological Science courses.

PSY 4900 : Advanced Research in Psychological Science

This course provides an opportunity for students to conduct advanced psychological research in a research laboratory in psychological sciences. This course may be repeated for credit.
Department
Psychology
Units 0/6
Recommended Background
an advanced understanding of psychological science research (PSY 3500, PSY 3900, or equivalent). Permission of the instructor is necessary to register.

System Dynamics

SD 1510 : Introduction to System Dynamics Modeling

The goal of this course is to provide students with an introduction to the field of system dynamics computer simulation modeling. The course begins with the history of system dynamics and the study of why policy makers can benefit from its use. Next, students systematically examine the various types of dynamic behavior that socioeconomic systems exhibit and learn to identify and model the underlying nonlinear stock-flow-feedback loop structures that cause them. The course concludes with an examination of a set of well-known system dynamics models that have been created to address a variety of socioeconomic problems. Emphasis is placed on how the system dynamics modeling process is used to test proposed policy changes and how the implementation of model-based results can improve the behavior of socioeconomic systems.
Department
System Dynamics
Category
Category I (offered at least 1x per Year)
Units 1/3

SD 2520 : Modeling Economic and Social Systems

The purpose of this course is to prepare students to construct original system dynamics computer simulation models of economic and social systems from real world situations. They are coached to experiment with these models to understand unintended consequences of policy and to design effective policy interventions. Such a modeling process can be used to examine the possible impacts of policy changes and technological innovations on socioeconomic systems. The curriculum in this course covers a detailed examination of the steps of the system dynamics modeling process: problem identification (including data collection and analysis), feedback structure conceptualization, model formulation, model testing and analysis, model documentation and presentation, and policy implementation, illustrated by examples from business, economy and social systems. This course together with either SSI505 or SD1510 can provide the basic background for the students to use system dynamics in their IQP/MQP projects. Students will not be granted credit for both SD 1520 and SD2520.

Department

System Dynamics

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

Fundamental systems thinking concepts as presented in SSI 505, SD1510, or permission of the instructor.

SD 2530 : Advanced Topics in System Dynamics Modeling

This course focuses on advanced issues and topics in system dynamics computer simulation modeling. A variety of options for dealing with complexity through the development of policy models, large-scale models and the partitioning of complex problems are discussed. Topics include model building, model validation, model analysis, the use of summary statistics and sensitivity measures, and policy design. The application of system dynamics to theory building and social policy are also reviewed.

Department

System Dynamics

Units 1/3

Recommended Background

SD 1510.

SD 3550 : System Dynamics Seminar

This special topics course is conducted as a research seminar, with many sessions being reserved for student presentations. Students will read, evaluate, and report on research papers representing the latest developments in the field of system dynamics. Classical system dynamics models may also be replicated and discussed. Students will complete projects that address specific problems using the system dynamics method.

Department

System Dynamics

Units 1/3

Recommended Background

SD 1510.

SS 1505 : Games for Understanding Complexity

This course addresses the theory and practice of developing solutions to complex social and environmental problems through interaction with roleplaying games and computer simulations designed to promote learning and improve decision-making. By interacting with a selection of games and case studies, students will learn to recognize the systemic causes of complex social and environmental problems and gain experience developing and using simulations to test policies for creating sustainable futures. Special attention will be given to appropriate modeling practices and the design of simulation experiments. The course is run in a laboratory format in which students work in groups to play games, develop simulation models and present them to the class for feedback before they revise and refine their work iteratively for final evaluation.

Department

General Social Science

System Dynamics

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

None Students who completed SS 150X cannot receive credit for SS 1505.

Sociology

SOC 1202 : Introduction to Sociology and Cultural Diversity

This course encourages students to explore how a sociological toolkit may be used to examine the impetus for social and historical changes and the effect such changes have on how individuals live, work, and find their place in this world. It operates from the premise that individual lives are not just personal but social— as humans we are shaped by the societies in which we live and the social forces at work within them. Major theoretical perspectives and concepts will be discussed over the course of the semester with primary emphasis on the roles that culture, dimensions of inequality and social change play in shaping individual lives. Students will also explore the influence that social institutions such as the family, religion, education, healthcare, government, economy, and environment have on how humans function within society.

Department

Sociology

Category

Category I (offered at least 1x per Year)

Units 1/3

General Social Science

ID 2050/SS 2050 : Social Science Research for the IQP

This course is open to students accepted to off-campus IQP centers and programs. The course introduces students to research design, methods for social science research, and analysis. It also provides practice in specific research and field skills using the project topics students have selected in conjunction with sponsoring agencies. Students learn to develop social science hypotheses based upon literature reviews in their topic areas and apply concepts drawn from social psychology, anthropology, sociology, economics and other areas as appropriate. Students make presentations, write an organized project proposal, and develop a communication model for reporting their project findings.

Department

General Social Science

Integrative & Global Studies

Category

Category I (offered at least 1x per Year)

Units 1/3

SS 1505 : Games for Understanding Complexity

This course addresses the theory and practice of developing solutions to complex social and environmental problems through interaction with roleplaying games and computer simulations designed to promote learning and improve decision-making. By interacting with a selection of games and case studies, students will learn to recognize the systemic causes of complex social and environmental problems and gain experience developing and using simulations to test policies for creating sustainable futures. Special attention will be given to appropriate modeling practices and the design of simulation experiments. The course is run in a laboratory format in which students work in groups to play games, develop simulation models and present them to the class for feedback before they revise and refine their work iteratively for final evaluation.

Department

General Social Science

System Dynamics

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

None Students who completed SS 150X cannot receive credit for SS 1505.

Society/Technology Studies

STS 1200 : Fundamentals of Global Health

The focus of global health research and practice is improving the overall health and health equity of all people worldwide. In this course, we will use an interdisciplinary approach to explore the major biological, social, political, environmental and economic determinants of health. We will analyze the dual burden of communicable and non-communicable disease facing the world's populations including study of current health systems, global health practices and priorities as well as major organization and institutional players. Class sessions will consist of lecture, intensive small group discussion, and global health case analyses. After successful completion of this course, students will be able to explain the basic principles of public health; discuss the determinants of health; describe how globalization has changed the patterns of the spread of disease and the methods needed to control disease; evaluate the complex, multi-faceted links between health, social and economic factors; and identify critical issues in the delivery of health care services, with a particular emphasis on challenges faced with regard to different cultural and economic settings.

Department
Society/Technology Studies
Category
Category I (offered at least 1x per Year)
Units 1/3

STS 4000 : Senior Seminar in Global Public Health

The course is designed to integrate each student's educational experience and interests in Global Public Health, (e.g., core global public health courses, specializations, and experience). Through seminar discussions and writing assignments students will critically reflect on what they learned in their previous courses and project experiences. In teams, students will prepare a final capstone paper and presentation that critically engages their educational experience in global public health and anticipates how their courses and experiences will translate into their future personal and professional. The course is especially designed as the capstone seminar for Global Public Health minors, but is also open to non-minors. This course will be offered in 2021-22, and in alternating years thereafter.

Department
Society/Technology Studies
Category
Category II (offered at least every other Year)
Units 1/3
Recommended Background
previous courses in global public health, and completion or concurrent registration with a global public health-related MQP, IQP or ISU.

Business

BUS 1020 : Global Environment of Business Decisions

The global nature of business is indisputable. This course introduces the students to the complexity of the global environment and adopts a multi-dimensional view (cultural, economic, social, legal, political, and technological) of world economy. It promotes understanding the global environment as integrative forces affecting the success or failure of today's businesses and fosters a global perspective. Topics may include an overview of the world economy, comparative advantage and international trade, cultural distance, FDI/globalization theory, outsourcing and global supply chain coordination, political and country risk, the global monetary system and currency risk, legal and ethical issues, and risk management.

Department
Business
Category
Category I (offered at least 1x per Year)
Units 1/3

BUS 2001 : WPI Means Business

This course is designed to broaden student perspectives on business through experiential learning in entrepreneurship, finance, strategy and marketing, organizational behavior, and operations. By exposing students to various business disciplines and a wide range of firms and business models, we intend to accelerate student impact through an engaging, immersive experience. During on and off-site situation workshops, students will engage with practitioners to discuss business challenges and decisions in a small-group format. Students will also be matched with alumni to de-brief topics related to cases and prepare a learning portfolio as a culminating assignment. By the end of the course students will have a broader understanding of business domains, increased business fluency, and a better understanding of decision-making within a relevant business context.

Department

Business

Category

Category I (offered at least 1x per Year)

Units 1/3

BUS 2020 : The Legal Environment of Business Decisions

This course addresses the impact of law on business. The course covers fundamental areas of business law, such as torts, contracts, intellectual property, and legal forms of business organizations, and their effects on business decisions. Particular attention is paid to technology-based enterprises where global business issues intersect with law.

Department

Business

Category

Category I (offered at least 1x per Year)

Units 1/3

BUS 2080 : Data Analysis for Decision Making

This course builds upon students' understanding of statistics and introduces them to the concepts and methods for analyzing data to support business decision-making. Students will explore data sets using data mining and analytics techniques to create business intelligence, to be used for understanding and improving customers' experiences, supply chain operations, product management, etc. During the course, students will develop an understanding of the uses of business data analytics and associated models for business decision-making, forecasting, and obtaining and maintaining a competitive advantage. Students will learn a comprehensive set of advanced spreadsheet skills, including how to design, build, test, and use spreadsheets for analyzing business decisions.

Department

Business

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Basic statistics, equivalent to that in MA 2611 and MA 2612.

BUS 4300 : Senior Seminar

This course is designed for the senior student who wishes to acquire or strengthen important skills needed for organizational success. Among the subjects covered is power in organizations, what it is, and how to acquire and appropriately use it. Additionally, this course emphasizes presentation skills, organizational etiquette, cross-cultural communication, and the knowledge of current events. The student will be expected to be familiar with and use all forms of media information for both individual and group projects. The course may be counted as a 4000-level elective for BU, MGE, or MIS, or as a Free Elective for any student at WPI.

Department

Business

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Senior standing.

Accounting

ACC 2060 : Financial Statements for Decision Making

This course provides students with an understanding of the primary financial statements used for internal and external business decision-making in start-up firms and large corporations. It emphasizes underlying accounting concepts captured in financial statements, while highlighting the interdependence among these statements. The course will cover analytical techniques, such as ratio analyses and sensitivity analyses to assess the impact of changes in strategy and outcomes on efficiency and effectiveness measures. It also describes the various users of internal and external financial statements, and the potential conflicts between these various stakeholders.

Department

Accounting

Category

Category I (offered at least 1x per Year)

Units 1/3

ACC 2101 : Management Accounting

This course is intended to familiarize the student with the wide variety of ways in which accounting data are used by management as a tool for the attainment of predetermined organizational objectives. The emphasis of the course is on the application of accounting data, rather than on its preparation, and particular attention is given to the use of financial data both in controlling day-to-day activities and planning future operations. Principal topics include: master budgets, cost analysis and classification systems, cost-volume-profit analysis, standard cost accounting and an introduction to capital budgeting. This course will be offered in 2021-22, and in alternating years thereafter.

Department

Accounting

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

ACC 2060.

Entrepreneurship

ECON 2910/ETR 2910 : Economics and Entrepreneurship

This course is designed to provide an introduction to economics, an introduction to entrepreneurship, and an understanding of the linkages between economics and entrepreneurship. Students will apply these concepts to the assessment of opportunities that might arise from participation in WPI projects. Students will engage in exploring how economics and entrepreneurship can inform opportunity assessment within an ambiguous and uncertain context. These decisions are always made with incomplete information and there is typically no single correct answer but rather multiple possible answers — each with pluses and minuses. Students may not earn credits for both ECON 2910/ETR 2910 and ECON 291X/ETR 29IX

Department

Economics

Entrepreneurship

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

None

ETR 1100 : Engineering Innovation and Entrepreneurship

In the modern competitive and global world confronting today's engineers, innovation and entrepreneurship (I&E) are increasingly important perspectives for every engineering career. Individuals proficient in I&E are likely to possess unique competitive advantage over those who do not. This course develops the foundation for developing such proficiency by examining the functional roles of the business/commercial aspects of engineering disciplines as well as establishing a basis for innovative thinking. Specific cases where I&E has led to new products innovation and new enterprise development will supplement course materials.

Department
Entrepreneurship
Category
Category I (offered at least 1x per Year)
Units 1/3

ETR 2900 : Social Entrepreneurship

This course will introduce students to the concept of social entrepreneurship and the ways in which social entrepreneurs are addressing complex social problems with their entrepreneurial ventures. Students will be exposed to the challenges and rewards of running a social enterprise. They will learn valuable business and entrepreneurial tools that can be applied to the design of sustainable social business models. Topics include social opportunity recognition and evaluation, business models in the social sector, social impact assessment, the double-bottom line, scalability of solutions, organizational forms and structures, and social venture financing.
This course will be offered in 2021-22, and in alternating years thereafter.

Department
Entrepreneurship
Category
Category II (offered at least every other Year)
Units 1/3
Recommended Background
Familiarity with concepts of creativity, innovation, entrepreneurial and critical thinking, ethics, cross-cultural relations, and social problems (OBC 1010, BUS 1020, ACC 2060 or equivalent).

ETR 3633 : Entrepreneurial Selling

Selling is a major part of business life, but it is especially important for those who are launching a new venture. They need to sell their business plan to potential investors. Later they need to sell their product or service to a customer. Ultimately they need to create an organization that is focused on meeting customer and other stakeholder needs through effective selling disciplines. This course will examine the elements of the sales cycle in terms of preparation, market research, prospecting, objection handling, closing, techniques for motivating the sales professional and formulation of strategy for the successful selling transaction. As part of the course students will be required to prepare individual sales presentations, one to secure investment for a new venture and one to sell a product or service to a customer. Guest speakers may be used on topics such as sales coaching, inside sales management, and to deliver sales effectiveness training.

Department
Entrepreneurship
Category
Category I (offered at least 1x per Year)
Units 1/3

ETR 3915 : Entrepreneurial Business Models

This course is designed to foster an understanding of entrepreneurship in the context of innovation and the global economy. It also provides the theoretical and practical knowledge for the preparation of business models. The course includes opportunity identification, team formation, capital and other resource acquisition, exit strategies and other aspects of new venture creation.

Department
Entrepreneurship
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
BUS 2020, ACC 2060, MIS 3010, OIE 3020 and OIE 2850.

ETR 4930 : Growing and Managing New Ventures

One of the most troublesome aspects of entrepreneurship is running the business once it is started. This course focuses on techniques to grow the new venture and how to manage both the growth and operations. Considerable emphasis will be placed on expanding existing markets, finding new markets, anticipating the next generation of products, and managing cash flow.

Department
Entrepreneurship
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
ACC 2101, OBC 1010, BUS 1020, BUS 2020, ACC 2060, MIS 3010, OIE 3020, MKT 4030, ETR 3913, OIE 2850.

Finance

FIN 1250 : Personal Finance

This course is designed to help the student make well-informed judgments when faced with personal financial decisions. Such decisions are growing in number and complexity, and both individuals and families need a considerable degree of financial expertise in order to utilize optimally their limited incomes. Principal topics include: insurance (medical, life, automobile and disability), consumer credit, estate planning, taxation, personal investments (real estate, securities, etc.), social security legislation and personal financial planning.

Department
Finance
Category
Category I (offered at least 1x per Year)
Units 1/3

FIN 2070 : Risk Analysis for Decision Making

This course provides a broad introduction to finance and financial logic, with emphasis on principles, applications and criteria used in decision-making. Core topics to be covered include interest rates, time value of money, bond valuation, yield curves, stock valuation, and risk and return analysis. The course is designed to help build students' financial literacy and provide a solid foundation for later courses in financial management, investments, and financial technology.

Department
Finance
Category
Category I (offered at least 1x per Year)
Units 1/3

FIN 3300 : Finance & Technology (FinTech)

This course develops expertise in Finance, Technology, Innovation, leadership, and decision-making by focusing on real-world challenges in the field of FinTech. We will be actively discussing and learning how to analyze, identify, and manage/innovate FinTech across many functional disciplines including Financial, Insurance, Banking, Trading, Information Technology, Regulation, and Budgeting. Students are introduced to the Financial industry and the FinTech ecosystem. The course adopts a decision-maker and leadership perspective (business, operational, functional, and technical leadership) by emphasizing the relationships among financial data, their underlying economic events, risk profiles, challenges/opportunities, and the responses by all stakeholders in a business/corporation.

Department
Finance
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
Introductory business and finance topics such as those found in ACC courses or ACC 2060.

FIN 3310 : Financial Markets and Digital Currencies

This course introduces students to the financial innovations and digital assets that are significantly transforming the banking and financial services sector. The course exposes students to strategic skills and analytical tools that prepare them to thrive in this digital age. The immersive experience will also include an understanding of the changing dynamics in the global banking and financial services sectors and how leveraging fintech and analytics can drive innovation and digital transformation. The course will also explore how digital currency innovations are increasingly altering basic financial intermediation functions such as payment processing, risk management, information dissemination, price discovery, capital raising, consumer expectations concerning access to funds, and the timing of loan decisions. Students will also spend time exploring the emerging challenges presented by the FinTech revolution, including traditional and emergent competitors as well as demographic, social, ethical, and technological forces facing the industry. Students will have hands-on problem-solving experiences that can be useful in FinTech applications and innovation. Students will demonstrate their knowledge through exercises, exams, and a final project that explores the raising of financing through the decentralized finance ecosystem.

Department

Finance

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Knowledge of Finance fundamentals (equivalent to that in FIN 2070). Basic knowledge of the financial industry would also be helpful (e.g., FIN 3300).

FIN 3330 : Financial Analysis

This course provides the foundation for financial data analytics used in business and FinTech applications. The objective of this course is for students to gain experience in analyzing financial data using modern machine learning techniques, statistical methods, and prediction models. Students will develop computational skills to perform data analysis using a modern statistical programming environment and apply these skills to address a range of problems encountered by business firms, including those in the FinTech industry. The topics discussed include an introduction to R language, visualization of financial data, cluster analysis, simple and multiple linear regression, classification models, high dimension data analysis using Lasso, and model assessment and selection using cross validation. Students will have hands-on experience in the development of data analytics applications to analyze real world financial problems.

Department

Finance

Category

Category I (offered at least 1x per Year)

Units 1/3

Management Information Systems

MIS 2300 : Business Applications of Blockchain

This course introduces the fundamental concepts and functionality of blockchain technology. It explores how that technology records, organizes, and verifies information and how it implements smart contracts. The various financial and non-financial applications of blockchain technology are reviewed. Students will demonstrate their knowledge through exercises, exams, and a final project that designs and develops a basic blockchain application for a business problem. The course concludes by examining the legal and regulatory framework, along with potential risks and hurdles faced by those implementing and using blockchain technologies for financial and other business contexts.

Department

Management Information Systems

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Basic knowledge of programming (Equivalent to CS 1004 or other introductory programming courses)

MIS 3010 : Creating Value Through Innovation

This course focuses on the ways value can be created and captured through innovation. Focusing on the assessment of customers, organizational capabilities, and competition, students will consider a variety of different types of innovations and their associated ethical and financial value propositions. Students will learn analytic tools to successfully assess and commercialize technology, product, and service innovations in a variety of contexts.

Department

Management Information Systems

Category

Category I (offered at least 1x per Year)

Units 1/3

MIS 3720 : Business Data Management

This course introduces students to the theory and practice of database management and the application of database software to implement business information systems that support managerial and operational decision-making. Special topics covered include relational data models, query languages, normalization, locking, concurrency control and recovery. The course covers data administration and the design of data tables for computerized databases. Students will use a commercial database package to design and implement a small business database application.

Department

Management Information Systems

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Some programming knowledge (e.g., CS 1004, CS 2119, OIE 2600 or equivalent knowledge)

MIS 3730 : Artificial Intelligence with Business Application

This course studies the problem of making computers act in ways which we call "intelligent". Topics include major theories, tools and applications of artificial intelligence, aspects of knowledge representation, searching and planning, and natural language understanding. Students will be expected to complete projects which express problems that require search in state spaces, and to propose appropriate methods for solving the problems.

Department

Management Information Systems

Category

Category I (offered at least 1x per Year)

Units 1/3

MIS 3787 : Business Applications of Machine Learning

This course offers a business focused data analytics introduction. Using cutting-edge tools and approaches to the analysis of data through supervised machine learning, the course teaches how to utilize “big data” for effective decision-making. The course creates data analytics skills through hands-on exposure to data and analytic techniques embedded in Automated Machine Learning tools. Application areas covered include Marketing (pricing and marketing of luxury shoes), Supply Chain (predicting parts backorders), Finance (predicting safe loans), Talent Management (predicting and explaining attrition), Service Delivery (predicting hospital readmissions), as well as student-centric topics (college grades and starting salaries). This course provides foundations required to successfully apply the machine learning approaches to many of the most common business problems.

Department

Management Information Systems

Category

Category I (offered at least 1x per Year)

Units 1/3

MIS 4084 : Business Intelligence

This course provides an introduction to the technologies and techniques for organizing, analyzing, visualizing, and presenting data about business operations in a way that creates business value, and prepares students to be knowledgeable producers and consumers of business intelligence. During the course, students will study a variety of business decisions that can be improved by analyzing large volumes of data about customers, sales, operations, and business performance. Students will employ commercially available business intelligence software to organize, summarize, visualize, and analyze data sets and make recommendations to decision makers based on the results. The course explores the technical challenges of conducting analytics on various forms of data including social media data and the managerial challenges of creating value from business intelligence expertise deployed in organizations. The course includes business cases, in-class discussion, hands-on analyses of business data, and methods for presenting results to decision makers. It is designed for any student interested in analyzing data to support business decision-making, including students whose primary focus is Management Information Systems, Marketing, Operations and Industrial Engineering, Business, Management Engineering, Data Science, or Computer Science.

Department

Management Information Systems

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Previous knowledge in data management, such as that provided by MIS 3720 Business Data Management or CS 3431 Database Systems I.

MIS 4720 : Systems Analysis and Design

This course integrates students' background in MIS in a one-term project focusing on development of creative solutions to open-ended business and manufacturing problems. The project will utilize systems analysis and design tools such as systems development life cycle, feasibility study, cost-benefit analysis, structured analysis and design. Students will acquire the skills necessary to analyze, develop, implement, and document real-life information systems. Students must be able to organize themselves and the project to complete their work within a seven week term. It is recommended that MIS majors take this course in preparation for their MQP.

Department

Management Information Systems

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

MIS 3720.

MIS 4741 : User Experience and Design

This course focuses on the newest developments in the field of user experience (UX) (e.g., the use of physiological measures such as eye tracking in UX design) and provides an introduction to various methods used in cutting-edge research laboratories to study user experience. Both theoretical concepts and practical skills with appropriate development tools will be addressed within the scope of the class through hands-on projects and assignments. Students will develop a plan to innovate with user experience and will implement a simple prototype of their plan.

Department

Management Information Systems

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

MIS 3010, CS 2102 (or CS 2103) or ability to program in a higher level programming language.

Marketing

MKT 3640 : Management of Process and Product Innovation

This course is based on the hypothesis that high performance firms depend on a sustainable pattern of new and innovative processes and products. Successful companies are examined in regard to their strategies for innovation and technology transfer. Technology alliances among industry, universities, and government are considered in order to increase the leverage of the individual firm. Benchmarking and commercialization from research to actualization is discussed through cases and examples.

Department
Marketing
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
FIN 2070 or OIE 2850.

MKT 3650 : Consumer Behavior

Knowing how to manage and interact with customers is a key component for business success. Today, customer needs are continuously evolving as well as how products and services are purchased and consumed. Understanding consumer behavior concepts allows firms to investigate consumption habits and make better informed managerial decisions. The goal of this course is to provide an introduction to various theories and dimensions of consumer behavior, such as the consumer decision-making process, the influence of attitude towards the product, brand, and/or firm, and the impact of culture and subculture. Students will be exposed to how these concepts are linked and applied to marketing, to our roles as consumers, and to everyday decisions.

Department
Marketing
Category
Category I (offered at least 1x per Year)
Units 1/3

MKT 4030 : Achieving Strategic Effectiveness

Every successful business has a strategy for how it provides value and earns profit within its particular industry. Focusing on the contexts of technology, innovation and entrepreneurship, this course develops analytic approaches for assessing the various aspects of strategy such as the competitive environment, the network of stakeholders, ethical implications, investor motivation, operational execution, and financial projections that are necessary to create a complete business plan.

Department
Marketing
Category
Category I (offered at least 1x per Year)
Units 1/3

Operations and Industrial Engineering

OIE 2081 : Introduction to Prescriptive Analytics

This course provides an introduction to prescriptive analytics, which involves the application of mathematical and computational sciences, such as linear optimization and simulation, to recommend optimal courses of action for decision making. The course will feature decision problems arising from a variety of contexts such as capacity management, finance, healthcare, humanitarian relief, inventory management, production planning, staffing, and supply chain. The emphasis of the course is the application of such techniques to recommend a best strategy or course of action for the particular context.

Department
Operations and Industrial Engineering
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
Basic statistics, equivalent to that in MA 2611 and MA 2612.

OIE 2600 : Scripting for Process and Productivity Improvement

This course will train students to think critically about the effective and efficient use of computational tools to enhance everyday organizational performance. Students will learn how to create value through productivity tools that will likely include advanced spreadsheet functionality, regular expressions, macros, and scripting. The course will make use of software including Microsoft Excel with Visual Basic for Applications, Python, and advanced text editors, applied to a variety of domains, to improve students' ability to automate processes and productivity. Students can receive credits for both OIE 2600 and either CS 2119 or CS 2102 or CS 2103. For IE majors, if one of the CS courses previously listed is used as a required programming course, then OIE 2600 can be used as an IE elective. *Students cannot receive credit for both OIE 2600 and OIE 3600.*

Department
Operations and Industrial Engineering
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
some previous exposure to analytical problem solving as found in OIE 2081 or MA 2210.

OIE 2850 : Engineering Economics

To aid all engineering students in understanding economics and business constraints on engineering decision making. Topics include evaluation of alternative; the six time-value-of-money factors; present worth, annual cash flow and rate-of-return analysis; incremental analysis; depreciation and income taxes; replacement analysis; inflation; handling probabilistic events; public economy; break-even and minimum cost points; and foreign exchange.

Department
Operations and Industrial Engineering
Category
Category I (offered at least 1x per Year)
Units 1/3

OIE 3020 : Achieving Effective Operations

Operations are embedded in a constantly changing network of relationships with various stakeholders including customers and suppliers. Within the organization, scarce resources (including financial, human, and technological) need to be allocated and aligned with strategic goals. External to the organization, consideration is given to sustainability and environmentally responsible use of resources. This course focuses on process analysis, engineering design thinking and process implementation within the constraints of stakeholder networks. Professional engineering ethics and the consequences of management decision making are discussed in detail. The course includes a process analysis project and a one-piece-flow hands on laboratory experience. Course assignments follow one-piece-flow principles in education, allowing individual students to complete the course at their own pace.

Department

Operations and Industrial Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

OIE 3405 : Work Systems and Facilities Planning

This course covers the fundamentals of developing efficient layouts for production and service facilities. Methods analysis, work measurement, material handling and material flow analysis are also covered. Mathematical models and computer tools are used to assist decision-making.

Department

Operations and Industrial Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

OIE 3020 and OIE 2081.

OIE 3410 : Materials Management in Supply Chains

This course in an introduction to the planning and controlling the material flow into, through, and out of an organization. It explains fundamental relationships among the activities that occur in the supply chain from suppliers to customers. In particular, the course addresses types of manufacturing systems, demand management and forecasting, master production scheduling, materials requirements planning, capacity management, inventory management, distribution resource planning, JIT and lean principles, and other current topics that are pertinent to managing the material flow of supply chains.

Department

Operations and Industrial Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

MA 1020, MA 1021, MA 2611 and OIE 3020.

OIE 3420 : Quality Planning, Design and Control

This course provides students with the analytical and management tools necessary to solve manufacturing and service quality problems. Topics include customer needs and quality, quality and cost relationships, process capability analysis, statistical process control, control charts for variables and attributes, design of experiments, and other Six Sigma problem solving methods. Health and safety outcomes and the ethical responsibility that quality assurance leadership owes to the organization's stakeholders is discussed in detail. Textbook problems and business school case studies form the foundation of the course as well as a hands-on project experience.

Department

Operations and Industrial Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Knowledge equivalent to that in OIE 3020 or OIE 3020 and MA 2612 or consent of the instructor.

OIE 3460 : Simulation Modeling and Analysis

This course covers the application of simulation to a variety of managerial problems with examples from operations management, industrial engineering and manufacturing engineering. It introduces the student to the concepts of computer simulation, with an emphasis on the design of a simulation experiment and statistical interpretation of its results. It will discuss simulation of queueing models, inventory and industrial dynamics, and gaming situations. The role and use of computers for the execution of simulations will also be highlighted. A commercial simulation language such as Arena will be used to solve problems from the manufacturing and service industries.

Department

Operations and Industrial Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

CS 1004 and MA 2612.

OIE 3510 : Stochastic Models

This is an introductory course in probabilistic models and decision-making under risk, with applications to engineering and management decision making. The course first covers quantitative methods for assessing and evaluating risks and how they are used in decision making. Decision making under risk is examined across a wide set of management and engineering problems. The course then introduces a set of probabilistic models commonly used in decision making and operations improvement; specifically, emphasis is placed on Markov chains, Poisson processes, and queuing theory, and their applications in manufacturing and service systems are illustrated.

Department

Operations and Industrial Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Knowledge of calculus and introductory probability and statistics.

OIE 4410 : Case Studies in Industrial Engineering

A number of in-depth case studies in operations and industrial engineering are analyzed. The cases will cover both manufacturing and service systems ranging from production system design to operations planning and control.

Department

Operations and Industrial Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

OIE 3020, OIE 2081, OIE 3410, and OIE 3510.

OIE 4430 : Advanced Prescriptive Analytics: From Data to Impact

This course provides an in-depth focus on prescriptive analytics, which involves the use of data, assumptions, and mathematical modeling of real-world decision problems to ascertain and recommend optimal courses of action. Starting from conceptualization of the problem, to using theory for translational modeling and techniques, to computational solving, and finally interpretation – likely in an iterative manner – students will gain knowledge of tools and practical skills in transforming real-world decision problems into actionable insights. Advanced topics in the prescriptive analytics domain will be covered, such as the use of integer variables to represent important logical constructs, using nonlinear functions to represent real-world decision aspects, the incorporation of stochasticity and uncertainty, and corresponding solution methods. Real-world problems will be selected from a variety of contexts that may include capacity management, data science, finance, healthcare, humanitarian operations, inventory management, production planning, routing, staffing, and supply chain.

Note: Students cannot take both OIE 4420 and OIE 4430 for credit.

Department

Operations and Industrial Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

An introductory level of exposure to prescriptive analytics or linear optimization, such as can be found in OIE 2081, MA 2210, or MA 3231.

Suggested

Note the mathematical foundations of some of the optimization techniques in this class are in MA 3231. Students might also benefit from MA 3233.

OIE 4460 : Global Planning and Logistics

This case-based course will examine methods and strategies for managing and controlling material movement, with particular emphasis on international operations, from the purchase of production materials to the control of work in process to the distribution of the finished product. Strategies that will be discussed include the design of international distribution networks, the use of third-party logistics providers, and the creation of links between logistic systems and marketing to create competitive advantage. The course will also explore tactical issues that must be managed to pursue a logistics strategy successfully, including choices regarding means of transportation, packaging, and inventory policies. Underlying themes of the course will be the use of information technologies (such as electronic data interchange and bar coding) and mathematical models to support logistics decision-making.

Department

Operations and Industrial Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

OIE 3020 and one of the following: FIN 2070 or OIE 2830 or consent of the professor.

Organizational Behavior and Change

OBC 1010 : Leadership Practice

Leadership is a critical role in any global, technological organization. This course explores how the concepts of creativity, entrepreneurial and critical thinking, emotional and self-awareness, passion, diversity, communication, and ethics inform and affect leadership practice. The course considers a variety of contemporary leadership challenges including how leaders work effectively across cultural, technological, and disciplinary boundaries, how leaders foster new ideas and bring them to fruition, how they communicate effectively and persuasively to diverse stakeholders, and how they make decisions that are both ethical and effective. The course is designed to 1) increase students' awareness of their own leadership styles, 2) examine the responsibilities of leadership, and 3) determine best practices in leadership.

Department

Organizational Behavior and Change

Category

Category I (offered at least 1x per Year)

Units 1/3

OBC 3354 : Organizational Behavior and Change

This course focuses on the basic knowledge and processes required of managers to understand behavior in organizations and to apply this knowledge to organizational change. Topics include communication and trust, power and leadership, group and intergroup processes, conflict and conflict management, and work and organizational design. Students apply their knowledge of organizational behavior to the analysis, implementation, and leadership of organizational change. Lectures, video presentations, case studies, group discussions and mini-projects are employed to introduce and illustrate the basic elements of organizational behavior and change.

Department

Organizational Behavior and Change

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

None.

OBC 4367 : Leadership, Ethics, and Social Responsibility

This upper-level course invites students to consider the importance of ethics, corporate governance, and corporate social responsibility for leading global enterprises effectively. Students will be asked to reflect on their own leadership styles and to engage the complex, ethical dimensions of leadership in modern organizations. The course will engage students using lecture, video presentations, case studies, guest speakers, fieldwork, and mini-projects.

Department

Organizational Behavior and Change

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

None.

Mechanical and Materials Engineering

BME 4503 : Computational Biomechanics

This course will focus on using computational modeling approaches, particularly, finite element models, to simulate, validate, and analyze the biomechanics involved in soft and hard tissue deformation and stress/strain analysis in quasi-static or impact conditions. First, students will be introduced to the process of setting specific analytical goals and establishing the need for a specific quantitative biomechanical model. Then, basic underlying principles of forward and inverse static/dynamics simulations are covered. Finally, multi-scale and multi-step models will be introduced. During the process, material models and property assignment will also be covered. Model building, testing, optimization and validation with experimental data will be discussed. An introduction to tools and techniques used in computational biomechanics will be provided.
Students may not receive credit for both BME 450X and BME 4503.
This course will be offered in 2022-23, and in alternating years thereafter.

Department

Biomedical Engineering
Mechanical and Materials Engineering

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

Basic knowledge of solid mechanics (ES 2501, ES 2502, ES 2503, ME 3501 or equivalent), differential and integral calculus (i.e., MA 2051 or equivalent), MATLAB programming (BME 2211 Data Analysis).

BME 4504/ME 4504 : Biomechanics

This course emphasizes the applications of mechanics to describe the material properties of living tissues. It is concerned with the description and measurements of these properties as related to their physiological functions. Emphasis on the interrelationship between biomechanics and physiology in medicine, surgery, body injury and prostheses. Topics covered include: Review of basic mechanics, stress, strain, constitutive equations and the field equations, viscoelastic behavior, and models of material behavior. The measurement and characterization of properties of tendons, skin, muscles and bone. Biomechanics as related to body injury and the design of prosthetic devices.

Department

Biomedical Engineering
Mechanical and Materials Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Mechanics (ES 2501, ES 2502, ES 2503, ME 3501), Mathematics (MA 2051).

BME 4606/ME 4606 : Biofluids

This course emphasizes the applications of fluid mechanics to biological problems. The course concentrates primarily on the human circulatory and respiratory systems. Topics covered include: blood flow in the heart, arteries, veins and microcirculation and air flow in the lungs and airways. Mass transfer across the walls of these systems is also presented. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Biomedical Engineering
Mechanical and Materials Engineering

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

Continuum Mechanics (ME 3501) and fluid mechanics equivalent to ES 3004.

BME 4814/ME 4814 : Biomaterials

A course discusses various aspects pertaining to the selection, processing, testing (in vitro and in vivo) and performance of biomedical materials. The biocompatibility and surgical applicability of metallic, polymeric and ceramic implants and prosthetic devices are discussed. The physico-chemical interactions between the implant material and the physiological environment will be described. The use of biomaterials in maxillifacial, orthopedic, dental, ophthalmic and neuromuscular applications is presented.

Department

Biomedical Engineering

Mechanical and Materials Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

BB 3130 or equivalent introduction to Human Anatomy, ES 2001 or equivalent Introduction to Materials Science and Engineering.

ISU : Special Topics

For students who wish to pursue in depth various mechanical engineering topics. Topics covered include: theoretical or experimental studies in subjects of interest to mechanical engineers. Registration as a junior or senior is assumed.

Department

Mechanical and Materials Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

ME 1520 : The Technology of Alpine SkIIng

This course explores science and engineering issues associated with equipment and technique for alpine skiing, particularly racing. A diverse group of technical subjects related to engineering mechanics are discussed: tribology, beams, rigid body motion, material science, machining and biomechanics. Specifically we will examine: ski-snow interactions, technique for gliding, turning and stepping, selection of line in racing; equipment design, testing and performance; and ski injuries. We will also address issues in the epidemiology of skiing injuries, the calculation of the cost of ski injuries to society, the impact of ski equipment technology on litigation and the impact of litigation on equipment and trail design. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Mechanical and Materials Engineering

Category

Category II (offered at least every other Year)

Units 1/3

ME 1800 : Manufacturing Science, Prototyping, and Computer-Controlled Machining

This course introduces students to manufacturing science and engineering and prototype part production. It emphasizes CNC (computer-controlled) machining. Students will learn how to go from a solid (CAD, computer-aided design) model to a machined part, using CAM software (computer-aided manufacturing) and CNC machining. They will also be exposed to associated issues in manufacturing process analysis, engineering design, material science, and in dimensional and surface metrology. Using machining as an example, the science of manufacturing processes is developed in a combination of class work and laboratory experience. The laboratory experience includes an experimental component that relates process variables in machining with performance and machined part quality. Students whose project work will necessitate fabrication of parts and those who want a background in manufacturing process science and engineering should take this course.

Department

Mechanical and Materials Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

ME 2300 : Introduction to Engineering Design

This project based course introduces students to the engineering design process including; identifying the need, benchmarking, writing design specifications, evaluating alternative designs and selecting a final design. Student groups will construct and evaluate a working prototype of their design. Additional topics include; creativity, product liability, reverse engineering, patents, and codes of ethics for engineers. Extensive written reports and oral presentations are required.

Department

Mechanical and Materials Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

computer-aided design (ES 1310), mechanics (ES 2501, ES 2502), and manufacturing (ME 1800).

ME 2312 : Introduction to Computational Solutions for Engineering Problems

The purpose of this course is to introduce concepts of programming and numerical methods using Matlab within an engineering framework. The course will review basic linear algebra, statics, stress analysis, and engineering governing equations with solution pathways developed and presented as numerical programming problems. The fundamental programming techniques cover a variety of input and output formats typically encountered in engineering situations. Control and conditional loops, recognizing and controlling numerical error, numerical integration and differentiation will be introduced and developed within an engineering framework.

Department

Mechanical and Materials Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Statics (ES 2501), Stress Analysis (ES 2502), General Physics-Mechanics (PH 1110), Differential and Integral Calculus (MA 1021, MA 1022) or equivalents.

ME 2820 : Materials Processing

An introduction to material processing in manufacturing. This course provides important background for anyone interested in manufacturing, design engineering design, sales, or management. Processing of polymers, ceramics, metals and composites is discussed. Processes covered include: rolling, injection molding, forging, powder metallurgy, joining and machining. The relationships between materials, processes, processing parameters and the properties of manufactured parts are developed. During the course the students should develop the ability to choose materials, processes, and processing parameters for designing manufacturing procedures to take a prototype part to production.

Department

Mechanical and Materials Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

ME 1800 Materials Selection and Manufacturing Processes, and ES 2001 Introduction to Materials Science.

ME 3310 : Kinematics of Mechanisms

An introduction to the synthesis and analysis of linkages, cams and gear trains is presented. The design process is introduced and used to solve unstructured design problems in linkage and cam design. Algebraic and graphical techniques to analyze the displacement, velocity and acceleration of linkages and cams are developed. Computer programs for the design and analysis of linkages are used by students. Results of student design projects are presented in professional engineering reports.

Department

Mechanical and Materials Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Ordinary Differential Equations (MA 2051), statics (ES 2501), dynamics (ES 2503).

ME 3311 : Dynamics of Mechanisms and Machines

This course provides an in-depth study of forces in dynamic systems. Dynamic force analysis is developed using matrix methods. Computer programs are used to solve the sets of simultaneous equations derived by students for realistic, unstructured design problems. Inertial and shaking forces, elementary mechanical vibrations, torque-time functions, rotational and reciprocating balance and cam dynamics are covered using the internal combustion engine as a design example. Students execute unstructured design projects and prepare professional engineering reports on the results. Computers are used extensively to solve the dynamic equations. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Mechanical and Materials Engineering

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

Ordinary Differential Equations (MA 2051), statics (ES 2501), dynamics (ES 2503), kinematics (ME 3310), linear algebra.

ME 3320 : Design of Machine Elements

This is an introductory course in mechanical design analysis, and it examines stress and fatigue in many machine elements. Common machine elements are studied and methods of selection and design are related to the associated hardware. Topics covered include: combined stresses, fatigue analysis, design of shafts, springs, gears, bearings and miscellaneous machine elements.

Department

Mechanical and Materials Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

mechanics (ES 2501, ES 2502, ES 2503), materials (ME 1800, ME 2820), computer programming (CS 1101 or CS 1102).

ME 3411 : Intermediate Fluid Mechanics

This course provides a mixture of theory and applications and covers topics not found in the introductory course in fluid mechanics. Topics include kinematics of fluid flow, potential flow, Navier-Stokes and the theory of viscous flow, basic turbulence, boundary layer theory, and introduction to compressible flow.

Department

Mechanical and Materials Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Introductory fluid mechanics (ES 3004, or equivalent).

ME 3501 : Elementary Continuum Mechanics

In typical mathematics courses, students learn principles and techniques by solving many short and specially prepared problems. They rarely gain experience in formulating and solving mathematical equations that apply to real life engineering problems. This course will give students this type of applied mathematical experience. The course emphasizes the application of basic laws of nature as they apply to differential elements which lead to differential equations that need to be solved; all of these ideas are used in higher level engineering science courses such as fluid mechanics, heat transfer, elasticity, etc. Emphasis will be placed on understanding the physical concepts in a problem, selecting appropriate differential elements, developing differential equations, and finding ways to solve these equations. Limitations on the mathematical solutions due to assumptions made will be considered. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Mechanical and Materials Engineering

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

Ordinary Differential Equations (MA 2051), statics (ES 2501), dynamics (ES 2503).

ME 3506 : Rehabilitation Engineering

This project based design course focuses on the design and use of devices to aid persons with disabilities. Human factors and ergonomics are integrated into all phases of the design process with particular emphasis on the user interface. Topics include: defining the problem, developing design specifications, development of preliminary designs, selection, realization and evaluation of a final design. Students will also learn how physical, and cognitive parameters, safety, economics, reliability and aesthetics need to be incorporated into the design process.

Department

Mechanical and Materials Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

mechanics (ES 2501, ES 2502, ES 2503), design (ME 2300), materials (ME 1800) and electrical engineering (ECE 2010).

ME 3820 : Computer-Aided Manufacturing

This introductory course in modern control systems will give students an understanding of the basic techniques, and the range of equipment used in most computer controlled manufacturing operations. The class work is reinforced by hands-on laboratories in the Robotics/CAM lab. Modeling and analysis of machining processes, and applications of PLC (programmable logic control) are included. Class topics include: Manufacturing Automation, Microcomputers for Process Monitoring and Control, Computer Numerical Control, Switching Theory and Ladder Logic, Transducers and Signal Conditioning, and Closed Loop Digital Control. The laboratories allow students to program and implement several types of the controllers, and will provide an introduction to the topic of industrial robotics.

Department

Mechanical and Materials Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

manufacturing (ME 1800), materials processing (ME 2820), elementary computer/logic device programming.

ME 3901 : Engineering Experimentation

A course designed to develop analytical and experimental skills in modern engineering measurement methods, based on electronic instrumentation and computer-based data acquisition systems. The lectures are concerned with the engineering analysis and design as well as the principles of instrumentation, whereas the laboratory periods afford the student an opportunity to use modern devices in actual experiments. Lecture topics include: review of engineering fundamentals and, among others, discussions of standards, measurement and sensing devices, experiment planning, data acquisition, analysis of experimental data, and report writing. Laboratory experiments address both mechanical and thermal systems and instrumentation in either traditional mechanical engineering (heat transfer, flow measurement/visualization, force/torque/strain measurement, motion/vibration measurement) or materials engineering (temperature and pressure measurements in materials processing, measurement of strain and position in mechanical testing of materials). Each year students will be notified which type of experiments will be used in each term offering. Students may also consult with their academic advisor or the Mechanical Engineering department office.

Department

Mechanical and Materials Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

mathematics (MA 2051), thermo-fluids (ES 3001, ES 3003, ES 3004), mechanics (ES 2501, ES 2502, ES 2503), materials (ES 2001).

ME 3902 : Project-Based Engineering Experimentation

This course is designed to develop experimental skills in engineering measurement methods, based on electronic instrumentation and computer-based data acquisition systems, such as the Raspberry Pi (a primarily digital microprocessor) and an Arduino (a primarily analog microcontroller). The lectures are concerned with the engineering design requirements as well as the principles of instrumentation, whereas the laboratory modules afford the student an opportunity to use these devices in actual experiments. Lecture topics include: discussions of standards, measurement and sensing devices, experiment planning, data acquisition, analysis of experimental data, and report writing. Laboratory experiments address mechanical (force/torque/strain measurements, motion/vibration measurements), energy (heat transfer, temperature, flow measurements), materials measurements (materials processing, measurement of strain and position in mechanical testing of materials), and instrumentation. The course culminates with an open-ended project of the students choosing. This open-ended project will illuminate the skills gained by the student to utilize multiple sensors and equipment to monitor and/or control physical situations.

Department

Mechanical and Materials Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

introductory heat transfer (ES 3003 or equivalent), introductory stress and dynamic mechanics (ES 2502 & ES 2503 or equivalents), introductory electrical and computer engineering (ECE 2010 or equivalent) and introductory materials (such as ES 2001 or equivalent).

ME 4320 : Advanced Engineering Design

This course integrates students' background in ME in a one-term design project that is usually taken from a local company. Students must organize themselves and the project to successfully realize a product that meets customer needs. Activities include problem definition, design analysis, mathematical modelling, CAD modelling, manufacturing, testing, liaison to vendors, customer relations, marketing, technical management, purchasing, report writing, and oral presentations.

Department

Mechanical and Materials Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

mechanisms (ME 3310, ME 3311), stress analysis (ES 2502), design (ME 3320), thermo-fluids (ES 3001, ES 3003, ES 3004), materials (ES 2001), manufacturing (ME 1800).

ME 4323 : Fundamentals of Drivetrain Systems

This product-oriented course focuses on engineering fundamentals of ground vehicle drivetrain systems with application to automobiles, commercial and off-road vehicles as well as autonomous and electrically driven ground vehicles. The course focuses on "theory and practice" aspects of engineering design of vehicle transmissions, transfer cases, open and limited slip differentials, etc. A term project integrates design principles with materials selection to improve a drivetrain component for a given vehicle. Project steps include: problem definition and analysis, development of design specifications, development and analysis of alternative designs, conceptual design and material analysis, and a CAE design.

Department

Mechanical and Materials Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

materials science (ES 2001), stress analysis (ES 2502), dynamics (ES 2503) or equivalents.

ME 4324 : Integrated Design of Mechanical Systems

This course develops student capabilities to conduct the detailed design of mechanical components integrated into a complete mechanical system. Topics covered include kinematic syntheses and analysis and detailed design of mechanical components under dynamic loading using the fatigue-life method. These topics are developed through a guided design project. Computer software packages such as Mathcad and Linkages are used.

Department
Mechanical and Materials Engineering
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
ES 2001 (Introduction to Materials Science), ES 1310 (Introduction to Computer Aided Design), ES2501 (Introduction to Static Systems), ES2502 (Stress Analysis), and ES2503 (Introduction to Dynamic Systems).

ME 4422 : Design and Optimization of Thermal Systems

This course introduces students to design of small and large scale optimal thermal systems. The hardware associated with thermal systems includes fans, pumps, compressors, engines, expanders, turbines, heat and mass exchangers, and reactors, all interconnected with some form of conduits. Generally, the working substances are fluids. These types of systems appear in such industries as power generation, electric and gas utilities, refrigeration and cryogenics, air conditioning and heating, food, chemical, petroleum, and other process industries. This course is intended for mechanical engineering students, especially those seeking a concentration in Thermal-Fluids. Additionally, this course might be of interest to students in Aerospace Engineering and Chemical Engineering.

Department
Mechanical and Materials Engineering
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
Knowledge in thermodynamics (ES 3001), fluid mechanics (ES 3004), heat transfer (ES 3003), and introduction to design (ME 2300)

ME 4424 : Radiation Heat Transfer Application and Design

Radiation Heat Transfer Applications will develop the student's knowledge of radiation and multi-mode heat transfer. Fundamentals of radiation will be covered: radiative properties of surfaces; view factors; exchange between black and grey surfaces; emission and absorption of gases; and flame radiation. Use of numerical methods will be emphasized as appropriate for solution of applications: the select numerical methods (numerical integration, matrix methods, ODE solutions) can be learned during the course. The course will conclude with a design exercise to be completed by each student. Each exercise will highlight radiation in a realistic scenario that requires multi-mode heat transfer and fluid mechanics analysis to develop the design solution. Exercise topics will come from subjects such as: solar power plants, solar effects on buildings, furnaces, fire safety in the built environment, etc. Students may not receive credit for both ME 4424 and ME 442X. This course will be offered in 2022-23, and in alternating years thereafter.

Department
Mechanical and Materials Engineering
Category
Category II (offered at least every other Year)
Units 1/3
Recommended Background
differential and integral calculus, and ordinary differential equations (MA 2031 or equivalent), and thermodynamics, fluid mechanics and heat transfer (ES 3001, 3004, 3003 or equivalents).

ME 4429 : Thermofluid Application and Design

This course integrates thermodynamics, fluid mechanics and heat transfer through the use of design projects involving modern technologies, such as electronic cooling, vapor compression power and refrigeration cycles. Activities include problem definition, design creation and analysis, mathematical modeling, cost analysis and optimization.

Department

Mechanical and Materials Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

knowledge in thermodynamics, fluid mechanics, heat transfer and introduction to design (ES 3001, ES 3004 and ES 3003, ME 2300 or equivalent).

ME 4430 : Integrated Thermomechanical Design and Analysis

Current state-of-the-art computer based methodologies used in the design and analysis of thermomechanical systems will be presented and illustrated by selected laboratory demonstrations, and used in projects. Projects will include thermal, mechanical, electronic, and photonic loads of steady state and dynamic nature and will integrate design, analysis, and testing. Students will prepare a technical report and present their results. Topics will include, but not be limited to, thermomechanics of fiber optic telecommunication cables, high-energy beam interactions with materials, shape memory alloys, microelectronics, MEMS and mechatronics. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Mechanical and Materials Engineering

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

MA 2051, ES 2001, ES 2502, ES 3003, ME 3901, and an introduction to design.

ME 4505 : Advanced Dynamics

Department

Mechanical and Materials Engineering

Units 1/3

ME 4506 : Mechanical Vibrations

This course is an introduction to the fundamental concepts of mechanical vibrations, which are important for design and analysis of mechanical and structural systems subjected to time-varying loads. The objective of the course is to expose the students to mathematical modeling and analysis of such systems Topics covered include: formulation of the equations of motion using Newton's Laws, D'Alembert's Principle and energy methods; prediction of natural frequency for single-degree-of-freedom systems; modeling stiffness characteristics, damping and other vibrational properties of mechanical systems; basic solution techniques by frequency response analysis and convolution integral methods. Examples may include analysis and design for transient passage through resonance; analysis and design of vibration measurement devices; introductory rotordynamics. The course is mainly focused on analysis of single-degree-of-freedom systems, however a basic introduction into multidegree-of-freedom systems is also presented. Computer-based project may be suggested.

Department

Mechanical and Materials Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Ordinary Differential Equations (MA 2501), Statics (ES 2501), Dynamics (ES 2503).

ME 4512 : Introduction to the Finite Element Method

This course serves as an introduction to finite element analysis (FEA) for stress analysis problems. Finite element equations are developed for several element types from stiffness and energy approaches and used to solve simple problems. Element types considered include spring, truss, beam, two-dimensional (plane stress/strain and axisymmetric solid), three-dimensional and plates. Stress concentrations, static failures, and fatigue failures are considered for each element type. Emphasis will be placed on knowing the behavior and usage of each element type, being able to select a suitable finite element model for a given problem, and being able to interpret and evaluate the solution quality. A commercial, general-purpose finite element computer program is used to solve problems that are more complex. Projects are used to introduce the use of FEA in the iterative design process.

Department

Mechanical and Materials Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Mathematics (MA 2051, MA 2071), Mechanics (ES 2501 & ES 2502 or CE 2000 & CE 2001).

ME 4710 : Gas Turbines for Propulsion and Power Generation

Department

Mechanical and Materials Engineering

Units 1/3

ME 4813 : Ceramics and Glasses for Engineering Applications

This course develops an understanding of the processing, structure, property, performance relationships in crystalline and vitreous ceramics. The topics covered include crystal structure, glassy structure, phase diagrams, microstructures, mechanical properties, optical properties, thermal properties, and materials selection for ceramic materials. In addition the methods for processing ceramics for a variety of products will be included.

Department

Mechanical and Materials Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

ES 2001 or equivalent.

ME 4821 : Plastics

This course develops the processing, structure, property, performance relationships in plastic materials. The topics covered include polymerization processes, chain structure and configuration, molecular weights and distributions, amorphous and crystalline states and glass-rubber transition. The principles of various processing techniques including injection molding, extrusion, blow molding, thermoforming and calendaring will be discussed. The physical and mechanical properties of polymers and polymer melts will be described with specific attention to rheology and viscoelasticity. Pertinent issues related to environmental degradation and recyclability will be highlighted. This course will be offered in 2021-22, and in alternating years thereafter.

Department

Mechanical and Materials Engineering

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

ES 2001 or equivalent.

ME 4832 : Corrosion and Corrosion Control

An introductory course designed to acquaint the student with the different forms of corrosion and the fundamentals of oxidation and electro-chemical corrosion. Topics covered include: corrosion principles, environmental effects, metallurgical aspects, galvanic corrosion, crevice corrosion, pitting, intergranular corrosion, erosion corrosion, stress corrosion, cracking and hydrogen embrittlement, corrosion testing, corrosion prevention, oxidation and other high-temper-ature metal-gas reactions.

Department

Mechanical and Materials Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

materials (ES 2001).

ME 4840 : Physical Metallurgy

Fundamental relationships between the structure and properties of engineering materials are studied. Principles of diffusion and phase transformation are applied to the strengthening of commercial alloy systems. Role of crystal lattice defects on material properties and fracture are presented. Strongly recommended as a senior-graduate level course for students interested in pursuing a graduate program in materials or materials engineering at WPI, or other schools.

Department

Mechanical and Materials Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

materials (ES 2001, ME 2820).

ME 4875/MTE 575 : Introduction to Nanomaterials and Nanotechnology

This course introduces students to current developments in nanoscale science and technology. The current advance of materials and devices constituting of building blocks of metals, semiconductors, ceramics or polymers that are nanometer size (1-100 nm) are reviewed. The profound implications for technology and science of this research field are discussed. The differences of the properties of matter on the nanometer scale from those on the macroscopic scale due to the size confinement, predominance of interfacial phenomena and quantum mechanics are studied. The main issues and techniques relevant to science and technologies on the nanometer scale are considered. New developments in this field and future perspectives are presented. Topics covered include: fabrication of nanoscale structures, characterization at nanoscale, molecular electronics, nanoscale mechanics, new architecture, nano-optics and societal impacts.

Department

Mechanical and Materials Engineering

Materials Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

ES 2001 Introduction to Materials or equivalent Some sections of this course may be offered as Writing Intensive (WI).

ME 5105 : Renewable Energy

Department

Mechanical and Materials Engineering

Units 1/3

RBE 4322/ME 4322 : Modeling and Analysis of Mechatronic Systems

This course introduces students to the modeling and analysis of mechatronic systems. Creation of dynamic models and analysis of model response using the bond graph modeling language are emphasized. Lecture topics include energy storage and dissipation elements, transducers, transformers, formulation of equations for dynamic systems, time response of linear systems, and system control through open and closed feedback loops. Computers are used extensively for system modeling, analysis, and control. Hands-on projects will include the reverse engineering and modeling of various physical systems. Physical models may sometimes also be built and tested.

Department

Robotics Engineering
Mechanical and Materials Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Mathematics (MA 2051, MA 2071), fluids (ES 3004), thermodynamics (ES 3001), mechanics (ES 2501, ES 2503)

Engineering Science Interdisciplinary

ES 1020 : Introduction to Engineering

This course is for first year students with an interest in engineering. The course focuses on the design process. Students are introduced to engineering through case studies and reverse engineering activities. Students will learn the steps in the design process and how engineers use this process to create new devices. Teams of students are then assigned a design project that culminates in building and evaluating a prototype of their design. Results of the design project are presented in both oral and written reports. This course does not require any prior engineering background. Note: This course can be used towards the Engineering Science and Design distribution requirement in IE and ME.

Department

Engineering Science Interdisciplinary

Category

Category I (offered at least 1x per Year)

Units 1/3

ES 1310 : Introduction to Computer Aided Design

This introduction course in engineering graphical communications and design provides a solid background for all engineering disciplines. The ability to visualize, create and apply proper design intent and industry standards for simple parts, assemblies and drawings is a necessity for anyone in a technology environment. Computer Aided Design software is used as a tool to create 2D & 3D sketches, 3D parts, 3D assemblies and 2D drawings per an industry standard. Multiview and pictorial graphics techniques are integrated with ANSI standards for dimensioning and tolerances, sectioning, and generating detailed engineering drawings. Emphasis is placed on relating drawings to the required manufacturing processes. The design process and aids to creativity are combined with graphics procedures to incorporate functional design requirements in the geometric model. No prior engineering graphics or software knowledge is assumed.

Department

Engineering Science Interdisciplinary

Category

Category I (offered at least 1x per Year)

Units 1/3

ES 1500 : Fundamentals of Systems Thinking

Systems Thinking is a holistic approach to problem solving that recognizes that system behavior and performance are the result of underlying structures. Systems Thinking provides tools that enable program managers, systems engineers, scientists, economists, and business managers to identify, understand, and control systems in order to improve system performance. The Systems Thinking analysis accounts for feedback and resistance to change often exhibited by real world systems. In this course, students will study system identification and delineation, causal loops and feedback diagrams, stock-and-flow diagrams, system leverage points, delays and oscillations, mental models and unintended consequences, and behavior patterns; and use these concepts to improve the performance of engineering, business, and complex social systems. The course will explore great system failures, how they might have been avoided, and how we can learn from them. Finally, students will learn how Systems Thinking explains the occasional irrational behavior of individuals, departments, businesses, and governments. Examples covered in this course may include the failure of strictly technological "fixes" to social issues (as in the government's installation of wells in Togo in the 1980s,) the 2008 financial meltdown, the failure of the Lockheed L-188 Electra Turboprop Airplane, the failure of the Tacoma Narrows Bridge ("Galloping Gertie") in 1940, the decline of many commercial fisheries around the world, the failure and success of companies like Research In Motion and Apple, and the unintended consequences of combating drug-related crime.

Department

Engineering Science Interdisciplinary

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

None.

ES 2001 : Introduction to Materials Science

This beginning course provides important background for all science and engineering disciplines regarding the capabilities and limitations of materials in our everyday lives. Students are introduced to the fundamental theme of materials science— structure-property-processing relationships—in metals, ceramics, and plastics. Aspects of material structure range from the atomic to microstructural and macroscopic scales. In turn, these structural features determine the properties of materials. In particular, this course investigates connections between structure and mechanical properties, and how working and thermal treatments may transform structure and thus alter material properties. This knowledge is then applied to material selection decisions.

Department

Engineering Science Interdisciplinary

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

prior knowledge of college-level chemistry.

ES 2501 : Introduction to Static Systems

This is an introductory course in the engineering mechanics sequence that serves as a foundation for other courses in mechanical engineering. The course covers general two- and three-dimensional force and couple systems, distributed loads, resultant forces, moments of forces, free body diagrams, equilibrium of particles and finite sized bodies. Specific topics include friction, trusses, shear forces, bodies subjected to distributed loads, bending moments in beams, and first and second moments of plane areas.

Department

Engineering Science Interdisciplinary

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Differential (MA 1021) and integral (MA 1022) calculus, vector algebra (MA 1023), and double and triple integration (MA 1024).

ES 2502 : Stress Analysis

This is an introductory course that addresses the analysis of basic mechanical and structural elements. Topics include general concepts of stresses, strains, and material properties of common engineering materials. Also covered are two-dimensional stress transformations, principal stresses, Mohr's circle and deformations due to mechanical and thermal effects. Applications are to uniaxially loaded bars, circular shafts under torsion, bending and shearing and deflection of beams, and buckling of columns. Both statically determinate and indeterminate problems are analyzed.

Department

Engineering Science Interdisciplinary

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

mechanical systems (ES 2501 or equivalent), differential (MA 1021) and integral (MA 1022) calculus, vector algebra (MA 1023), and double and triple integration (MA 1024).

ES 2503 : Introduction to Dynamic Systems

Engineers should be able to formulate and solve problems that involve forces that act on bodies which are moving. This course deals with the kinematics and dynamics of particles and rigid bodies which move in a plane. Topics covered will include: kinematics of particles and rigid bodies, equations of motion, work-energy methods, and impulse and momentum. In this course a basic introduction to mechanical vibration is also discussed. Basic equations will be developed with respect to translating and rotating coordinate systems.

Department

Engineering Science Interdisciplinary

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Statics (ES 2501 or CE 2000).

ES 2800 : Environmental Impacts of Engineering Decisions

Engineering decisions can affect the environment on local and global scales. This course will introduce students to concepts that will make them aware of the ramifications of their engineering decisions, and is intended for engineering students of all disciplines. Specific topics the course will cover include: environmental issues, waste minimization, energy conservation, water conservation and reuse, regulations (OSHA, TSCA, RCRA, etc.), lifecycle assessment, risk assessment, sustainability, design for the environment, and environmental impact statements. Energy and mass balances will be applied to activities that impact the environment. Instruction will be provided through lectures, practitioner seminars, and a term project. Intended audience: all engineering majors desiring a general knowledge of the environmental impacts of engineering decisions. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Engineering Science Interdisciplinary

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

elementary college chemistry; second year students.

ES 3001 : Introduction to Thermodynamics

This course emphasizes system and control volume modeling using conservation of mass and the First and Second Laws of Thermodynamics. Topics include an introduction to heat, work, energy, and power, properties of simple substances, and cycle analysis for power production and refrigeration.

Department

Engineering Science Interdisciplinary

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

basic physics, (PH 1110, PH 1111) elementary differential and integral calculus (MA 1021, MA 1022) or equivalents.

ES 3002 : Mass Transfer

This course introduces the student to the phenomena of diffusion and mass transfer. These occur in processes during which a change in chemical composition of one or more phases occurs. Diffusion and mass transfer can take place in living systems, in the environment, and in chemical processes. This course will show how to handle quantitative calculations involving diffusion and/or mass transfer, including design of process equipment. Topics may include: fundamentals of diffusional transport, diffusion in thin films; unsteady diffusion; diffusion in solids; convective mass transfer; dispersion; transport in membranes; diffusion with chemical reaction; simultaneous heat and mass transfer; selected mass transfer operations such as absorption, drying, humidification, extraction, crystallization, adsorption, etc.

Department

Engineering Science Interdisciplinary

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

fundamentals of chemical thermodynamics, fluid flow and heat transfer; ordinary differential equations (MA 2051 or equivalent).

ES 3003 : Heat Transfer

This course presents the fundamentals of heat transfer in the three modes of conduction, convection, and radiation. Topics include steady-state and transient heat conduction, forced external and internal convection, natural convection, heat exchanger analysis, radiation properties, and radiative exchange between surfaces.

Department

Engineering Science Interdisciplinary

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

knowledge of thermodynamics, fluid mechanics, and ordinary differential equations (ES 3001, ES 3004, and MA 2051) or equivalents.

ES 3004 : Fluid Mechanics

A study of the fundamental laws of statics, kinematics and dynamics applied to fluid mechanics. The course will include fluid properties, conservation of mass, momentum and energy as applied to real and ideal fluids. Laminar and turbulent flows, fluid resistance and basic boundary layer theory will also be considered.

Department

Engineering Science Interdisciplinary

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

basic physics, basic differential equations and vectors.

ES 3011 : Control Engineering I

Characteristics of control systems. Mathematical representation of control components and systems. Laplace transforms, transfer functions, block and signal flow diagrams. Transient response analysis. Introduction to the root-locus method and stability analysis. Frequency response techniques including Bode, polar, and Nichols plots. This sequence of courses in the field of control engineering (ES 3011) is generally available to all juniors and seniors regardless of department. A good background in mathematics is required; familiarity with Laplace transforms, complex variables and matrices is desirable but not mandatory. All students taking Control Engineering I should have an understanding of ordinary differential equations (MA 2051 or equivalent) and basic physics through electricity and magnetism (PH 1120/1121). Control Engineering I may be considered a terminal course, or it may be the first course for those students wishing to do extensive work in this field. Students taking the sequence of two courses will be prepared for graduate work in the field. Students may not receive credit for both ES 3011 and ECE 3012.

Department

Engineering Science Interdisciplinary

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Ordinary Differential Equations (MA 2051) and Electricity and Magnestism (PH 1120, PH 1121).

ES 3323 : Advanced Computer Aided Design

This course is intended to strengthen solid modeling and analysis skills with an emphasis on robust modeling strategies that capture design intent. The use of solid models for applications in mechanical design and engineering analysis is emphasized. Topics include: advanced feature-based modeling, variational design, physical properties, assembly modeling, mechanisms, and other analytical methods in engineering design.

Department

Engineering Science Interdisciplinary

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

familiarity with drafting standards (ES 1310), mechanical systems (ES 2501 or CE 2000, ES 2503), strength of materials (ES 2502 or CE 2001) and kinematics (ME 3310) is assumed. Additional background in machine design (ME 2300, ME 3320) is helpful.

ES 3501 : A Project-Based Introduction to Systems Engineering

Systems Engineering is a multifaceted discipline, involving human, organizational, and various technical variables that work together to create complex systems. This course is an introduction and overview of the methods and disciplines that systems engineers use to define and develop systems, with a particular focus on capstone projects. The course will include specific integrated examples, projects, and team building exercises to aid in understanding and appreciating fundamental principles. Topics covered will include: Introduction to Systems Engineering; Requirements Development; Functional Analysis; System Design; Integration, Verification and Validation; Trade Studies and Metrics; Modeling and Simulation; Risk Management; and Technical Planning and Management.

Department

Engineering Science Interdisciplinary

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Third or fourth year standing as an undergraduate student, preferably in engineering or science, or permission of the instructor.

Manufacturing Engineering

MFE 510 : Control and Monitoring of Manufacturing Processes

Department
Manufacturing Engineering
Units 1/3

MFE 511 : Application of Industrial Robotics

Department
Manufacturing Engineering
Units 1/3

MFE 520 : Axiomatic Design of Manufacturing Processes

Department
Manufacturing Engineering
Units 1/3

MFE 530 : Computer Integrated Manufacturing

Department
Manufacturing Engineering
Units 1/3

MFE 540 : Design for Manufacturability

Department
Manufacturing Engineering
Units 1/3

Materials Engineering

ME 4875/MTE 575 : Introduction to Nanomaterials and Nanotechnology

This course introduces students to current developments in nanoscale science and technology. The current advance of materials and devices constituting of building blocks of metals, semiconductors, ceramics or polymers that are nanometer size (1-100 nm) are reviewed. The profound implications for technology and science of this research field are discussed. The differences of the properties of matter on the nanometer scale from those on the macroscopic scale due to the size confinement, predominance of interfacial phenomena and quantum mechanics are studied. The main issues and techniques relevant to science and technologies on the nanometer scale are considered. New developments in this field and future perspectives are presented. Topics covered include: fabrication of nanoscale structures, characterization at nanoscale, molecular electronics, nanoscale mechanics, new architecture, nano-optics and societal impacts.

Department
Mechanical and Materials Engineering
Materials Engineering
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
ES 2001 Introduction to Materials or equivalent Some sections of this course may be offered as Writing Intensive (WI).

Aerospace Engineering

AE 2110 : Introduction to Incompressible Fluid Dynamics

This course covers the fundamentals of inviscid and viscous incompressible fluid dynamics. Topics presented will be considered from the following: fluid kinematics and deformation; integral conservation laws of mass, momentum and energy for finite systems and control volumes; differential conservation laws of mass, momentum and energy; the Navier-Stokes equations; the streamfunction and the velocity potential. Applications will be considered from the following topics: hydrostatics; incompressible, inviscid, irrotational (potential) flows; incompressible boundary layer flows; viscous incompressible steady internal and external flows; and dimensional analysis.

Department

Aerospace Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

differential equations (MA2051 or equivalent), dynamics (ES 2503, or equivalent), thermodynamics (ES 3001, PH 2101, CH 3510 or equivalent).

AE 2310 : Introduction to Aerospace Control Systems

This course introduces feedback control systems analysis and design for applications to aircraft and spacecraft. Topics include: linear dynamical systems modeling of aircraft and spacecraft motion, including linearization; identification and transient response analysis of typical modes of motion; time- and frequency domain analysis; Bode plots; criteria for stability; design of stability augmentation and, attitude and orbital control systems using linear state feedback or PID control; numerical simulation of controlled and uncontrolled aircraft and spacecraft motion.

Department

Aerospace Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

ordinary differential equations (MA 2051 or equivalent), introductory dynamics (ES 2503, PH 2201 or equivalent), and linear algebra (MA 2071 or equivalent).

AE 2320 : Introduction to Orbital Mechanics

An introductory course that covers the fundamentals of space flight. Topics studied include: two-body orbital dynamics, classification of orbits, and time of flight analysis; geocentric orbits and impulsive maneuvers: orbit shaping, escape trajectories, Hohmann and non-Hohmann transfers; orbital elements in 3D; interplanetary Hohmann and generalized transfers, intercepts, flybys.

Department

Aerospace Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

multivariable calculus (MA 1024 or equivalent), differential equations (MA 2051 or equivalent), dynamics (ES 2503, PH 2201 or equivalent).

AE 2410 : Introduction to Aerospace Structures

This course provides a concise overview of statics and then focuses on basic stress analysis applied to simple aerospace structures. Topics in stress analysis include: concepts of stress and strain; basic constitutive relations; one-dimensional response to axial loading; thermal stresses; statically determinate and indeterminate problems; shear forces, bending moments, bending stresses and deflections in beams with symmetric cross-sections; two-dimensional stress transformation and Mohr's circle; and an introduction to energy methods in structural analysis.

Department

Aerospace Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

differential, integral, multivariable calculus (MA 1021, MA 1022, MA 1024 or equivalent), mechanics.

AE 3110 : Fundamentals of Compressible Fluid Dynamics

In this course, students are introduced to various compressibility phenomena such as compression (shock) and expansion waves. Conservation laws and thermodynamic principles are applied to the description of flows in which compressibility effects are significant. One-dimensional models are applied to analysis of flow in variable area ducts, normal and oblique shock waves, expansion waves, and flows with friction and heat addition. Numerous applications from engineering are investigated including supersonic inlets, rocket nozzles, supersonic wind tunnels, gas delivery systems, and afterburning jet engines.

Department

Aerospace Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

thermodynamics, incompressible fluid dynamics (AE 2110 or equivalent).

AE 3120 : Fundamentals of Aerodynamics

This course introduces students to the aerodynamics of airfoils, wings, and aircraft in the subsonic and supersonic regimes. Topics covered include: prediction of aerodynamic forces (lift, drag) and moments, dynamic similarity, experimental techniques in aerodynamics, Kutta-Joukowski theorem, circulation, thin airfoil theory, panel methods, finite wing theory, subsonic compressible flow over airfoils, linearized supersonic flow, and viscous flow over airfoils.

Department

Aerospace Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

incompressible and compressible fluid dynamics (AE 2110, AE 3110 or equivalent).

AE 3310 : Fundamentals of Navigation and Communication

This course covers methods and current technologies in the analysis, synthesis, and practice of aerospace guidance, navigation, and communications systems. Topics covered include: attitude- and position kinematics, inertial navigation systems, global satellite navigation systems, communication architectures for satellite navigation, satellite link performance parameters and design considerations, tropospheric and ionospheric effects on radio-wave propagation, least squares estimation, and the Kalman filter.

Department

Aerospace Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

linear algebra (MA 2071 or equivalent), dynamics (ES 2503, PH 2201 or equivalent), and controls (AE 2310 or equivalent).

AE 3420 : Fundamentals of Aerospace Structures

This course focuses on intermediate-level topics in stress analysis relevant to aerospace structures. Topics include: buckling under centric and eccentric loadings with and without lateral loads applied; torsion of solid circular and noncircular cross sections; torsion of thin-walled multi-celled members; flexural shear flow in and shear center of thin walled multi-celled members; bending stresses in beams with unsymmetric cross sections; stresses under combined loadings; and three-dimensional states of stress. The laboratory component of this course provides testing and measurement experience related to buckling of columns under a variety of loadings and support conditions; and to the determination of the shear center and bending response of beams with unsymmetric cross sections.

Department

Aerospace Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

differential equations (MA 2051 or equivalent), introductory aerospace structures (AE 2410 or equivalent.)

AE 3430 : Fundamentals of Composite Materials

This course provides an overview of the processing techniques and mechanical behavior of composite materials relevant to aerospace applications. Topics in this course may include: classification of composites; elasticity of composite materials; the effect of reinforcements on strength and toughness; bonding mechanisms of interfaces in composite; fabrication methods for polymer-matrix composite materials; viscoelasticity and creep of composites; advanced composites materials (bio-composites, nano-composites).

Department

Aerospace Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

introductory material science (ES 2001), and introductory stress analysis (AE 2410 or equivalent).

AE 4210 : Fundamentals of Air-Breathing Propulsion

This course introduces the principles of operation of air-breathing engines, including gas-turbines (turbojets, turbofans, and turboprops), ramjets, and scramjets. Topics covered include: engine thrust and efficiency analysis; working principles and performance analysis of diffusers, compressors, combustors, and nozzles; parametric cycle analysis; effect of irreversibilities on performance. The topics covered are also relevant to the operation of gas-turbines used for power generation.

Department

Aerospace Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

thermodynamics (ES 3001, CH 3510, PH 2101 or equivalent), compressible fluid dynamics (AE 3110 or equivalent).

AE 4220 : Fundamentals of Rocket Propulsion

This course provides a study of rocket propulsion systems for launch vehicles and spacecraft. Dynamics, performance, and optimization of rocket-propelled vehicles are presented. Performance and component analysis of chemical propulsion systems are covered including flight dynamics, vehicle staging, nozzle design, and thermochemistry of bipropellant and monopropellant thrusters. Different classes of electric thrusters are introduced along with the concept of optimal specific impulse.

Department

Aerospace Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

compressible fluid dynamics (AE 3110 or equivalent), thermodynamics (ES 3001, PH 2101, or equivalent).

AE 4310 : Fundamentals of Aircraft Dynamics and Control

This course covers models of fixed-wing aircraft dynamics, and the design of aircraft control systems. Topics include: aircraft performance, longitudinal and lateral flight dynamics, simulation methodologies, natural modes of motion, static and dynamic stability, and aircraft control systems (such as autopilot design, flight path control, and automatic landing).

Department

Aerospace Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

controls (AE 2310 or equivalent), attitude and position kinematics (or equivalent).

AE 4320 : Fundamentals of Spacecraft Dynamics and Control

The course covers broad topics in spacecraft attitude dynamics, stability and control. The course includes a review of particle and two-body dynamics and introduction to rigid body dynamics. Orbital and attitude maneuvers are presented. Attitude control devices and momentum exchange techniques such as spinners, dual spinners, gravity gradient, and geomagnetic torques are presented. Attitude sensors/actuators are presented and the attitude control problem is introduced. Open-loop stability analysis for a variety of equilibrium conditions is discussed. Control using momentum exchange and mass expulsion (thrusters) devices is discussed. The analyses and designs will be implemented using scientific computing software such as MATLAB®.

Department

Aerospace Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Orbital Mechanics (AE 2320 or equivalent), dynamics (ES 2503, PH 2201 or equivalent), controls (AE 2310 or equivalent).

AE 4410 : Fundamentals of Structural Dynamics

This course introduces the analysis of vibrations of flexible bodies encountered as elements of aircraft and space structures. Topics include: modeling of aerospace structures with lumped parameters using Newton's Law and Lagrange's equations, free- and forced- vibration response of single degree of freedom systems and multi-degree of freedom systems, design of simplified vibration absorption systems, dynamic testing, modal analysis for determining structural response of lumped and continuous systems.

Department

Aerospace Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

dynamics (ES 2503, PH 2201, or equivalent), controls (AE 2310 or equivalent), aerospace structures (AE 3420 or equivalent).

AE 4510 : Aircraft Design

This course introduces students to design of aircraft systems. Students complete a conceptual design of an aircraft in a term-long project. Students are exposed to the aircraft design process, and must establish design specifications, develop and analyze alternative designs, and optimize their designs to meet mission requirements. Students work together in teams to apply material learned in the areas of aerodynamics, aerospace materials, structures, propulsion, flight mechanics, and stability and control, to the preliminary design of an aircraft. The project requirements are selected to reflect real-life aircraft mission requirements, and teams are required to design systems which incorporate appropriate engineering standards and multiple realistic constraints. The teams present their design in a final report and oral presentation.

Department

Aerospace Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

aerodynamics (AE 3120 or equivalent), aerospace structures (AE 3420 or equivalent), air breathing propulsion (AE 4210 or equivalent), aircraft dynamics and control (AE 4310 or equivalent).

AE 4520 : Spacecraft and Mission Design

This course introduces students to design of spacecraft and missions. Students are introduced to the process of designing a spacecraft and major subsystems to meet a specific set of objectives or needs. In addition, students will learn about different spacecraft subsystems and what factors drive their design. Students complete a term-long spacecraft design project conducted by teams. The project addresses orbital mechanics, the space environment, attitude determination and control, telecommunications, space structures, and propulsion, along with other spacecraft subsystems. The project requirements are selected to reflect real-life missions, and teams are required to design systems which incorporate appropriate engineering standards and multiple realistic constraints. The teams present their design in a final report and oral presentation.

Department

Aerospace Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

orbital mechanics (AE 2320 or equivalent), space environments (PH 2550 or equivalent), spacecraft dynamics and control (AE 4320 or equivalent), telecommunications (AE 3310), space structures (AE 3420 or equivalent), rocket propulsion (AE 4220 or equivalent)

PH 2550/AE 2550 : Atmospheric and Space Environments

This course introduces the ambient atmospheric and space environments encountered by aerospace vehicles. Topics include: the sun and solar activity; the solar wind; planetary magnetospheres; planetary atmospheres; radiation environments; galactic cosmic rays; meteoroids; and space debris.

Department

Physics

Aerospace Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

mechanics (PH 1110/1111 or equivalent), electromagnetism (PH 1120/1121 or equivalent), and ordinary differential equations (MA 2051 or equivalent).

Biomedical Engineering

BME 1001 : Introduction to Biomedical Engineering

This course uses lectures, demonstrations, projects and scientific literature readings on the major branches of biomedical engineering. A series of guest lectures, including device demonstrations introduce students to the many branches of biomedical engineering. Course work for BME 1001 is based on small, creative projects focusing on primary literature, department research, global health, and biomedical engineering as a whole.

Department

Biomedical Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

BME 1004 : Introduction to Programming in Matlab

This course will introduce basic and essential programming skills in modern engineering program language, Matlab, to all BME students. The course will include basic programming syntax, control structures, data structures (vectors, matrices, structures, cell arrays), 2D images, 3D image volumes, string manipulations, File I/O, figure plotting/visualization, image display, and basic graphical user interface (GUI) design. NOTE: The course does not count for engineering credits, but will fulfill the computer programming requirement for BME students.

Department

Biomedical Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

none.

BME 2001 : Introduction to Biomaterials

This beginning course provides important background for all science and engineering disciplines regarding the capabilities and limitations of materials relevant to the development of medical devices. Students are introduced to the fundamental theme of materials science — structureproperty-processing relationships in biomaterials, specifically metals, ceramics, and plastics. Aspects of material structure range from the atomic to microstructural and macroscopic scales. In turn, these structural features determine the properties of materials. In particular, this course investigates connections between structure and mechanical properties, and how working and thermal treatments may transform structure and thus alter material properties. This knowledge is then applied to material selection decisions for the design of medical devices and engineered tissues. Students who have previously received credit for ES 2001 or BME 2811 may not receive credit for BME 2001.

Department

Biomedical Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

prior knowledge of college-level chemistry and physics.

BME 2210 : Biomedical Signals, Instruments and Measurements

This course is an introduction to the instrumentation methods used to measure, store and analyze the signals produced by biomedical phenomena. The goal of this course is to familiarize students with the basic design and implementation of techniques for measuring a broad scope of signal types for molecular, cellular and physiological research. Sensors used for acquiring electrical, magnetic, optical/spectral and chemical signals will be covered. Topics include the underlying physics and chemistry of biomedical signals, biosensor types and usage, amplification and signal conditioning, data acquisition methods, and sources of artifact and noise.

Department

Biomedical Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

PH 1120/21, CH 1010 or equivalent.

BME 2211 : Biomedical Data Analysis

To learn the fundamentals of basic signal processing methods as well as linear time series analyses framework for modeling and mining biological data. Tools of data analysis include statistics for determining significance of a result, Laplace and Z transforms, convolution, correlation, sampling theorem, Fourier transform, transfer function, coherence function and various filtering techniques. The goal of this course is to offer the students an opportunity to learn and model and simulate static and dynamic physiological systems using linear systems theory. First principles of chemistry and physics are used to quantitatively model physiological systems. Most of the models are based on linear systems theory. Simulations and estimation are performed using Matlab and already-developed software.

Department

Biomedical Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

BME 2210, CS 1004 or equivalent.

BME 2502 : Introduction to Biomechanics: Stress Analysis

This is an introductory course that addresses the analysis of basic mechanical and structural elements relevant to biomechanics. Topics include general concepts of stresses, strains, and material properties of biomaterials and biological materials including viscoelasticity. Also covered are stress concentrations, two-dimensional stress transformations, principal stresses, and Mohr's circle. Applications are to uniaxially loaded bars, circular shafts under torsion, bending and shearing and deflection of beams. Both statically determinate and indeterminate problems are analyzed.

Department

Biomedical Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Differential (MA 1021) and integral (MA 1022) calculus, vector algebra (MA 1023), physics mechanics (PH 1110 or PH 1111), and statics (ES 2501). Students who have previously received credit for BME 2511 or ES 2502 may not receive credit for BME 2502.

BME 2610 : Introduction to Bioprocess Engineering

This course is an introduction to fundamental material and energy balances related to the field of Biomedical Engineering. The fundamentals of bioprocess engineering calculations and data analysis, and bioengineering processes and process variables will be covered. Students will learn to identify a system, define boundary conditions, and characterize the system processes to generate appropriate material and energy balances using the principles of conservation of mass and energy. Fundamentals and applications in the human body and biomanufacturing are examined. Specific examples may include an organ, multiple organs or the entire body, bioprocess instrumentation, individual or groups of cells, cell culture bioreactors, tissue engineered scaffolds, and drug delivery systems.

Department

Biomedical Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Basic knowledge of differential and integral calculus (e.g. MA 1021 and MA 1022 or equivalent), human biology (e.g., BB 1025 or equivalent), and chemistry (e.g. CH 1010 and CHI020 or equivalent).

BME 3012 : Biomedical Sensors Laboratory

This laboratory-based course is designed to develop hands-on experimental skills relevant to the selection and application of various sensors used to acquire biomedical signals.

Department

Biomedical Engineering

Category

Category I (offered at least 1x per Year)

Units 1/6

Recommended Background

BME 2210, ECE 2010, ECE 2019 or equivalent. Students who have previously taken BME 3011 may not receive credit for this course.

BME 3013 : Biomedical Instrumentation Laboratory

This laboratory-based course is designed to develop hands-on experimental skills relevant to the design and application of analog instrumentation commonly used to acquire biomedical signals.

Department

Biomedical Engineering

Category

Category I (offered at least 1x per Year)

Units 1/6

Recommended Background

BME 2210, ECE 2010, ECE 2019 or equivalent. Students who have previously taken BME 3011 may not receive credit for this course.

BME 3014 : Physiological Signals Laboratory I: Techniques

This course is an introduction to the computational methods used to extract and analyze the signals produced by biomedical phenomena. The goal of this course is to familiarize the student with implementing the most common algorithmic approaches for data analysis used in biomedical engineering. Coursework will cover programming for topics such as peak detection, spectral analysis and the fast Fourier transform FFT method, auto-regression analysis, polynomial trend removal, and signal filtering methods.

Department

Biomedical Engineering

Category

Category I (offered at least 1x per Year)

Units 1/6

Recommended Background

A first course in MATLAB such as BME 2211, BME 1004 or equivalent.

BME 3111 : Physiology and Engineering

This course provides students with an understanding of mammalian physiology and the engineering aspects of different physiological systems. The course will have both a lecture and laboratory portion. The laboratory portion will provide the students with the ability to analyze and interpret data from living systems, which is a required ABET program criteria for student majoring in Biomedical Engineering. The course will focus on a number of organ systems that may include cardiovascular, respiratory, and renal. Engineering principles that include biomechanical, bioelectrical, and biofluids will be applied to physiological systems.

Department

Biomedical Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

A knowledge of Cell Biology (such as BB 2550), biomechanics and biotransport (such as BME 2502), and signal analysis (such as BME 2210) or equivalent.

BME 3112 : Human Physiology for Biomedical Engineers

This course provides students with an understanding of the structure, function and pathologies of physiological systems such as the cardiovascular, respiratory, and the renal system. The course will teach the mechanisms of organ function from an engineering standpoint that help students understand the principles and techniques employed in designing devices used to treat or correct pathological conditions in these organ systems. Students will gain a better understanding of the interface between physiology and device design used in medical devices such as stents, catheters, pacemakers, ECG machines, and other devices as applicable. Special emphasis will be given to group discussions where students will discuss disease pathologies and review the devices used to treat those conditions. Students will be encouraged to review the device design and suggest improvements for better patient outcomes. Other topics covered in the course include regenerative medicine, biomedical ethics and the concept of "Bioinspired design". This course will not count towards the "Biomedical Engineering and Engineering" course requirement for Biomedical Engineering majors. *Students who have received credit for BME3111 cannot receive credit for BME3112.*

Department

Biomedical Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

A knowledge of Human biology (such as BB 1025 or equivalent) and
Cell Biology (such as BB 2550 or equivalent).

BME 3300 : Biomedical Engineering Design

Students are guided through the open-ended, real-world, design process starting with the project definition, specification development, management, team interactions and communication, failure and safety criteria, progress reporting, marketing concepts, documentation and technical presentation of the final project outcome. The course will include a significant writing component, will make use of computers, and hands-on design explorations. Students who have previously received credit for BME 2300 may not receive credit for BME 3300.

Department

Biomedical Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

BME 3503 : Skeletal Biomechanics Laboratory

This laboratory course will help students increase their knowledge of the mechanics of the musculoskeletal system. Students will gain understanding of the course materials and technical skills through the combined hands-on application of state-of-the-art biomechanical testing equipment and computer simulation modules towards solving authentic problems involving balance, strength, and movement.

Department

Biomedical Engineering

Category

Category I (offered at least 1x per Year)

Units 1/6

Recommended Background

Statics (ES 2501) and dynamics (ES 2503). Students who have previously taken BME3504 may not receive credit for this course.

BME 3505 : Solid Biomechanics Laboratory: Techniques

This laboratory-driven solid biomechanics course provides hands-on experience in characterizing the mechanical properties of biological tissues such as bone, tendons, ligaments, skin, and blood vessels and their synthetic analogs. Students gain an in-depth understanding of the course material by performing uniaxial tension and compression, bending, and torsion tests on hard and soft tissues using industry-standard testing equipment and completing mechanical and statistical analysis of the data. Some sections of this course may be offered as Writing Intensive (WI).

Department

Biomedical Engineering

Category

Category I (offered at least 1x per Year)

Units 1/6

Recommended Background

A solid knowledge of mechanics of materials (ES2502) and material science (ES 2001). Students who have previously taken BME3504 may not receive credit for this course.

BME 3506 : Solid Biomechanics Laboratory: Applications

This laboratory-driven solid biomechanics course provides hands-on experience in characterizing the mechanical properties of biological tissues such as bone, tendons, ligaments, skin, and blood vessels and their synthetic analogs, in the context of an authentic challenge. Students gain an in-depth understanding of the course material from personal observations, measurements, and analysis of biological tissues and synthetic replacement/fixation materials using industry-standard testing equipment. A challenge-based laboratory project will be assigned which will require the students to determine and execute effective test methods at their own pace in a team setting and communicate their findings effectively. Some sections of this course may be offered as Writing Intensive (WI).

Department

Biomedical Engineering

Category

Category I (offered at least 1x per Year)

Units 1/6

Recommended Background

Ability to independently perform tensile and bending tests using a uniaxial mechanical testing machine and to perform mechanical and statistical analysis of test data (BME3505). Students who have previously taken BME3504 may not receive credit for this course.

BME 3605 : Biotransport Laboratory II: Applications

This laboratory-driven transport course provides hands-on experience in measuring heat, flow, and transport in biologically-relevant systems. Students gain an in-depth understanding of the course material from personal observations and measurements on model cardiovascular systems and connective tissues. Challenge-based laboratory projects will be assigned which will require the students to determine and execute effective test methods at their own pace in a team setting and communicate their findings effectively. Systems modeled may include blood vessels, stenotic vessels, and aneurysms. Connective tissues tested may include blood vessels and skin.

Department

Biomedical Engineering

Category

Category I (offered at least 1x per Year)

Units 1/6

Recommended Background

Basic Chemistry (CH 1010, CH 1020), Basic Physics (PH 1010), Material Science (ES 2001 or BME 2001), stress analysis (ES 2502 or BME 2502) and a knowledge of cell biology (BB 2550), or equivalent.

BME 3610 : Transport Analysis in Bioengineering

This course provides an overview of the modeling and analysis of fluid and mass transport processes related to the field of Biomedical Engineering and Bioprocess Engineering. Fundamentals and applications of hydrostatics, conservation of mass and momentum in modeling and analysis of biological fluid transport processes in the human body and bioprocess equipment are presented and discussed. It includes modeling and analysis of blood and biological fluid flow through blood vessels, capillary beds and bioprocess equipment. Modeling and analysis of diffusive and convective mass transport in biological conduits and membranes, selective permeability and nutrient/waste exchange in parenchymal tissues with transport barriers unique to biological systems such as intact and fenestrated endothelium. Basic concepts of pharmacokinetics such as plasma clearance, volume of distribution of drugs and other biological solutes in body tissues are also covered. Surface adsorption and membrane permeability concepts are covered in the context of biological soluted exchange in capillaries and bioprocess operations. Students may not receive credit for both BME 3610 and BME 36IX.

Department

Biomedical Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Basic knowledge of differential and integral calculus (e.g., MA 2051 or equivalent), fundamental knowledge of biological system function or cell function (e.g., BB 1035 or BB 2550 or equivalent), fundamentals of data analysis and process modeling such as some of the topics covered in BME 2211 or BME 2610 or ChE 2011, or equivalent.

BME 3811 : Biomaterials Lab

This laboratory-driven course provides hands-on experience in the design, fabrication and characterization of biomaterials for medical applications. Students will use synthetic and natural polymer materials to fabricate a scaffold for applications such as tissue engineering, wound healing or controlled drug delivery. A challenge-based laboratory project will be assigned which will require the students to design a biomaterial scaffold that meets specific design criteria, and quantitatively assess the properties of this scaffold to evaluate how well the criteria were met. Design criteria may include mechanical strength, biocompatibility, porosity, degradation rate, or release kinetics. Students will complete the project at their own pace in a team setting and communicate their findings effectively.

Department

Biomedical Engineering

Category

Category I (offered at least 1x per Year)

Units 1/6

Recommended Background

Basic chemistry (CH 1010 and CH 1020) and a knowledge of material science (ES 2001) or equivalent.

BME 3813 : Cellular Engineering Lab

This laboratory-driven course provides hands-on experience in the application of bioengineering to control cellular processes. Students will be challenged to design an intervention to manipulate a specific cellular process (adhesion, proliferation, migration, differentiation) and use modern cellular and molecular biology tools to assess and refine their approach. Laboratory exercises will provide an overview of cell culture technique, microscopy and molecular probes, quantification of cell proliferation and migration, and assessment of cellular differentiation in the context of the assigned projects. Students will complete the project at their own pace in a team setting and communicate their findings effectively.

Department

Biomedical Engineering

Category

Category I (offered at least 1x per Year)

Units 1/6

Recommended Background

Basic chemistry (CH 1010 and CH 1020) and a solid knowledge of cell biology (BB 2550) or equivalent.

BME 4011/ECE 4011 : Biomedical Signal Analysis

Introduction to biomedical signal processing and analysis. Fundamental techniques to analyze and process signals that originate from biological sources: ECGs, EMGs, EEGs, blood pressure signals, etc. Course integrates physiological knowledge with the information useful for physiologic investigation and medical diagnosis and processing. Biomedical signal characterization, time domain analysis techniques (transfer functions, convolution, auto- and cross-correlation), frequency domain (Fourier analysis), continuous and discrete signals, deterministic and stochastic signal analysis methods. Analog and digital filtering. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Biomedical Engineering
Electrical and Computer Engineering

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

ECE 2311, ECE 2312, or equivalent.

BME 4023/ECE 4023 : Biomedical Instrumentation Design

This course builds on the fundamental knowledge of instrumentation and sensors. Lectures cover the principles of designing, building and testing analog instruments to measure and process biomedical signals. The course is intended for students interested in the design and development of electronic bioinstrumentation. Emphasis is placed on developing the student's ability to design a simple medical device to perform real-time physiological measurements.

Department

Biomedical Engineering
Electrical and Computer Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

BME 3012, BME 3013, ECE 2010 or ECE 2019.

BME 4201 : Biomedical Imaging

This course provides an understanding of fundamental principles of various biomedical imaging modalities as well as computational image analysis. Topics include: light microscopy, computed tomography, magnetic resonance imaging, computational image analysis, and review of computer vision theory and the relevant principles of physics. Course work uses examples from light microscopy, computed tomography, X-ray radiography, and magnetic resonance imaging. Familiarity with a high-level programming language is recommended. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Biomedical Engineering

Category

Category II (offered at least every other Year)

Units 1/3

BME 4300 : MQP Capstone Design

This course guides students through the engineering design process during the first term of their MQP to aid them in fulfilling their capstone design requirement. The course focuses on developing a revised client statement based on the objectives, constraints, and functions of the design. Methods for concept generation, concept selection and development strategy will be covered. In addition, project planning tools, business plans, ethics, and design for manufacturability and sustainability will be covered. BME 4300 cannot be used to fulfill graduate degree requirements.

Department

Biomedical Engineering

Category

Category I (offered at least 1x per Year)

Units 1/6

Recommended Background

Principles of engineering design such as BME 3300 or equivalent. Course should be taken concurrently with the MQP. Students who have taken BME 430X may not get credit for BME 4300.

BME 4503 : Computational Biomechanics

This course will focus on using computational modeling approaches, particularly, finite element models, to simulate, validate, and analyze the biomechanics involved in soft and hard tissue deformation and stress/strain analysis in quasi-static or impact conditions. First, students will be introduced to the process of setting specific analytical goals and establishing the need for a specific quantitative biomechanical model. Then, basic underlying principles of forward and inverse static/dynamics simulations are covered. Finally, multi-scale and multi-step models will be introduced. During the process, material models and property assignment will also be covered. Model building, testing, optimization and validation with experimental data will be discussed. An introduction to tools and techniques used in computational biomechanics will be provided.
Students may not receive credit for both BME 450X and BME 4503.
This course will be offered in 2022-23, and in alternating years thereafter.

Department

Biomedical Engineering
Mechanical and Materials Engineering

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

Basic knowledge of solid mechanics (ES 2501, ES 2502, ES 2503, ME 3501 or equivalent), differential and integral calculus (i.e., MA 2051 or equivalent), MATLAB programming (BME 2211 Data Analysis).

BME 4504/ME 4504 : Biomechanics

This course emphasizes the applications of mechanics to describe the material properties of living tissues. It is concerned with the description and measurements of these properties as related to their physiological functions. Emphasis on the interrelationship between biomechanics and physiology in medicine, surgery, body injury and prostheses. Topics covered include: Review of basic mechanics, stress, strain, constitutive equations and the field equations, viscoelastic behavior, and models of material behavior. The measurement and characterization of properties of tendons, skin, muscles and bone. Biomechanics as related to body injury and the design of prosthetic devices.

Department

Biomedical Engineering
Mechanical and Materials Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Mechanics (ES 2501, ES 2502, ES 2503, ME 3501), Mathematics (MA 2051).

BME 4606/ME 4606 : Biofluids

This course emphasizes the applications of fluid mechanics to biological problems. The course concentrates primarily on the human circulatory and respiratory systems. Topics covered include: blood flow in the heart, arteries, veins and microcirculation and air flow in the lungs and airways. Mass transfer across the walls of these systems is also presented. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Biomedical Engineering
Mechanical and Materials Engineering

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

Continuum Mechanics (ME 3501) and fluid mechanics equivalent to ES 3004.

BME 4701 : Cell and Molecular Bioengineering

This course examines the principles of molecular and cell biology applied to the design of engineered molecules, cells and tissues. Topics will include the basic structural, chemical and physical properties of biomolecules (proteins, lipids, DNA and RNA), application of biomolecules to monitor and alter cellular processes in vitro and in vivo, and design considerations for engineering cell and molecular therapeutics. Case studies will be used to examine specific applications of molecular and cellular bioengineering technologies to treat disease and promote tissue repair and regeneration. Students who earned credit for BME 37XX may not receive credit for BME 4701.

Department

Biomedical Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Cell biology (BB 2550). Additional coursework in molecular biology (BB 2950) and/or genetics (BB 2920) would be beneficial.

BME 4814/ME 4814 : Biomaterials

A course discusses various aspects pertaining to the selection, processing, testing (in vitro and in vivo) and performance of biomedical materials. The biocompatibility and surgical applicability of metallic, polymeric and ceramic implants and prosthetic devices are discussed. The physico-chemical interactions between the implant material and the physiological environment will be described. The use of biomaterials in maxillifacial, orthopedic, dental, ophthalmic and neuromuscular applications is presented.

Department

Biomedical Engineering

Mechanical and Materials Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

BB 3130 or equivalent introduction to Human Anatomy, ES 2001 or equivalent Introduction to Materials Science and Engineering.

BME 4828 : Biomaterials-Tissue Interactions

This course examines the principles of materials science and cell biology underlying the design of medical devices, artificial organs and scaffolds for tissue engineering. Molecular and cellular interactions with biomaterials are analyzed in terms of cellular processes such as matrix synthesis, degradation and contraction. Principles of wound healing and tissue remodeling are used to study biological responses to implanted materials and devices. Case studies will be analyzed to compare tissue responses to intact, bioresorbable and bioerodible biomaterials. Additionally, this course will examine criteria for restoring physiological function of tissue and organs and investigate strategies to design implants and prostheses based on control of biomaterial-tissue interactions.

Department

Biomedical Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

BB 2550 or equivalent, ES 2001 or equivalent, PH 1110 or PH 1111.

BME 4831 : Drug Delivery

The course examines fundamental composition, structure, property and performance relationships in classical and novel drug delivery systems as part of disease treatment strategies (i.e. cancer, organ damage). Physiological barriers to drug delivery and methods to overcome these barriers are analyze. The course will familiarize students with biomaterial-based drug delivery systems that have recently been developed. Topics include routes of drug administration, diffusion, Fick's law, pharmacokinetics/pharmacodynamics, drug modifications, materials for drug delivery (implantable, transdermal, injectable), antibody therapeutics, cells as drugs and drug delivery vehicles, and novel drug formulations and delivery systems.

Department

Biomedical Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Fundamental knowledge of biomaterials (e.g. BME 2001 or equivalent), multivariable calculus (e.g. MA 1024 or equivalent) and biological system function or cell function (e.g., BB 1035 or BB 2550 or equivalent)

Chemical Engineering

CE 4063/CHE 4063 : Transport & Transformations in the Environment

In this course, students will learn to make quantitative relationships between human activities and the effects on water, soil, and air in the environment. Students will learn the scientific and engineering principles that are needed to understand how contaminants enter and move in the environment, how compounds react in the environment, how to predict their concentrations in the environment, and how to develop solutions to environmental problems. Topics to be covered may include water quality engineering (including microbial interactions), air quality engineering, and hazardous waste management. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Civil, Environmental & Architectural Engineering

Chemical Engineering

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

Familiarity with transport phenomena, such as in ES 3004 (Fluid Mechanics) and ES 3002 (Mass Transfer), and familiarity with reaction kinetics and reactor design, such as through CHE 3201 (Kinetics and Reactor Design). Background such as CE 3059 (Environmental Engineering), CE 3060 (Water Treatment), or CE3061 (Wastewater Treatment) is suggested.

CHE 554/CH 554 : Molecular Modeling

This course trains students in the area of molecular modeling using a variety of quantum mechanical and force field methods. The approach will be toward practical applications, for researchers who want to answer specific questions about molecular geometry, transition states, reaction paths and photoexcited states. No experience in programming is necessary; however, a background at the introductory level in quantum mechanics is highly desirable. Methods to be explored include density functional theory, ab initio methods, semiempirical molecular orbital theory, and visualization software for the graphical display of molecules.

Department

Chemical Engineering

Chemistry and Biochemistry

Units 1/3

CHE 1011 : Introduction to Chemical Engineering

This course provides an introduction to the broad and vital discipline of chemical engineering including conventional and developing chemical technologies. An introduction is provided to the first principles of chemical engineering, as well as environmental, health, safety and ethical issues in chemical engineering practice. An overview is provided of the chemical engineering profession, career choices, the course of study, and a survey of the chemical industry, e.g., polymer, pharmaceutical, food processing, microelectronic, electrochemical, biotechnology, process control, energy, and petroleum refining. Course activities include guest speakers and plant trips. Recommended for first-year students with a basic knowledge of chemistry.

Department

Chemical Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

CHE 2011 : Chemical Engineering Fundamentals

This first course in chemical engineering is designed to give students the ability to use techniques and solve problems of interest to chemical engineers. Students will learn fundamental material by completing analysis, design, and/or laboratory projects. Topics covered include: material balances and stoichiometry, pressure, volume, and temperature behavior of pure fluids, 1st law of thermodynamics, vapor-liquid equilibria with ideal thermodynamics, and staged separation processes.

Department

Chemical Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Elementary college chemistry and calculus. Students may not receive credit towards CHE distribution requirements for both CHE 2011 and CM 2001.

CHE 2012 : Elementary Chemical Processes

This course aims to build a strong foundation in analysis of chemical processes via a project-based approach. Topics covered include analysis and design of stagewise separation processes such as distillation, 1st and 2nd law (of thermodynamics) analysis of power and refrigeration cycles, and application of material and energy balances in industrial chemical processes, including those with recycle and non-ideal systems. Students may not receive credit towards CHE distribution requirements for both CHE 2012 and ES 3000.

Department

Chemical Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Elementary college chemistry and calculus and some familiarity with the topics listed in CHE 2011.

CHE 2013 : Applied Chemical Engineering Thermodynamics

This course uses a project-based approach to build confidence and competence in the use of chemical engineering thermodynamics for the analysis and design of chemical processes. Topics covered include extractive separation systems, solution thermodynamics and nonreacting multicomponent mixtures, phase equilibria and property changes on mixing. Students may not receive credit towards CHE distribution requirements for both CHE 2013 and CM 2102.

Department

Chemical Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Elementary college chemistry and calculus and some familiarity with the topics listed in CHE 2011 and CHE 2012.

CHE 2014 : Advanced Chemical Processes

This course builds on prior work in material and energy balances, chemical engineering thermodynamics, and stagewise separation processes to facilitate student mastery and design of more complex processes. Topics covered include chemical reaction equilibria, material and energy balances for non-steady state systems, combined material and energy balances, humidification, and batch distillation. Students may not receive credit towards CHE distribution requirements for both CHE 2014 and CM 2002. Some sections of this course may be offered as Writing Intensive (WI).

Department

Chemical Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Elementary college chemistry and calculus and some familiarity with the topics listed in CHE 2011, CHE 2012, and CHE 2013.

CHE 3201 : Kinetics and Reactor Design

Techniques for experimentally determining rate laws for simple and complex chemical reactions, the mechanisms and theories of chemical reactions, the function of catalysts, and the design of isothermal, adiabatic, batch and flow reactors. The course is intended to provide chemists and chemical engineers with the conceptual base needed to study reactions and perform in the design and analysis of reactors.

Department

Chemical Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

differential equations, thermodynamics and some organic chemistry.

CHE 3301 : Introduction to Biological Engineering

This course is an introduction to the chemical engineering principles involved in modern applications of biological engineering. Topics may include: an introduction to biology, biochemistry, physiology, and genomics; biological process engineering including fermentation, mammalian cell culture, biocatalysis, and downstream bioseparations; drug discovery, development, and delivery; environmental biotechnology; and chemical engineering aspects of biomedical devices. This course will be offered in 2021-22, and in alternating years thereafter.

Department

Chemical Engineering

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

material and energy balances, thermodynamics, organic chemistry, and differential equations.

CHE 3501 : Applied Mathematics in Chemical Engineering

The consolidation of the methods of mathematics into a form that can be used for setting up and solving chemical engineering problems. Mathematical formulation of problems corresponding to specific physical situations such as momentum, energy and mass transfer, and chemical reactions. Analytical and numerical techniques for handling the resulting ordinary and partial differential equations and finite difference equations.

Department

Chemical Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

ordinary differential equations, partial derivatives and vectors, momentum heat and mass transfer.

CHE 3702 : Energy Challenges in the 21st Century

The goal of this course is to prepare students for future work in energy-related fields by providing an overview of the challenges related to energy production. Students will study several major energy systems. The details of such energy systems will be examined using engineering principles, particularly focusing on relevant chemical processes. For example, the details and processes of a typical power plant or a refinery will be examined. Students will also become familiar with environmental and economic issues related to energy production. Topics to be covered may include: fossil fuels, the hydrogen economy, biofuels, nuclear energy, fuel cells, batteries, and the electricity grid. Students may not receive credit for both CHE 3702 and CHE 320X. This course will be offered in 2021-22, and in alternating years thereafter.

Department

Chemical Engineering

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

knowledge of chemistry (CH 1010, 1020, 1030), differential and integral calculus, and chemical processes (CHE 2011).

CHE 3722 : Bioenergy

The primary goal of this course is to provide students the necessary understanding and tools to evaluate biochemical and thermochemical biofuel production technologies. The secondary goals include developing understanding of 1) fuel properties, 2) biomass resources, 3) basic enzyme kinetics, 4) biochemical reactor design, 5) the corn ethanol process, 6) challenges to cellulosic ethanol, 7) biomass gasification reactions and thermochemistry, 8) gasification reactor design, and 9) techno economic concepts of biofuel processes. Students may not receive credit for both CHE 372X and CHE 3722. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Chemical Engineering

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

Knowledge of chemistry (CH 1010, 1020, and 1030 or equivalent), differential and integral calculus and differential equations (MA 1021-1024 and 2051 or equivalent), and chemical processing (CHE 2011 or equivalent).

CHE 4401 : Unit Operations of Chemical Engineering I

Laboratory-application of fundamental theories to practical chemical engineering operations. Emphasis is on building the student's understanding and ability to approach the problems of design and operations of large scale chemical processing equipment. The course is a combination of lectures and laboratory projects in the area of unit operations. Laboratory projects include experiments in fluid-flow phenomena through various media such as: friction in conduits, filtration, pressure drop in packed towers, fluidization of solids, and spray drying. Students are expected to carry out the planning and execution of experimental work as well as the analysis and reporting of experimental results in both written and oral format.

Department

Chemical Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

knowledge of chemistry, mathematics and engineering principles.

CHE 4402 : Unit Operations of Chemical Engineering II

Overall format and procedure are essentially the same as in Unit Operations of Chemical Engineering I. Laboratory projects include experiments in heat and mass transfer such as: heat transfer in two heaters and a cooler, climbing film evaporation, multiple effect evaporation, absorption, extraction, distillation and rotary drying of solids.

Department

Chemical Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

familiarity with techniques and procedures emphasized in CHE 4401.

CHE 4403 : Chemical Engineering Design

Design of equipment, systems and plants; discussion of factors important in chemical plant design such as: economics, cost estimation, profitability, process selection, materials of construction, process control, plant location and safety. Introduction to optimization and computer-aided design. Principles are illustrated with short industrial-type problems.

Department

Chemical Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

thermodynamics; heat, mass and momentum transfer; inorganic and organic chemistry; chemical kinetics and reactor design.

CHE 4404 : Chemical Plant Design Project

Application of Chemical Engineering design principles to the design of a major chemical plant. Students work in groups to produce a preliminary practical process flowsheet, equipment and plant design, and economic analysis.

Department

Chemical Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

familiarity with techniques and procedures emphasized in CHE 4403.

CHE 4405 : Chemical Process Dynamics and Control Laboratory

This course is intended to provide laboratory application of fundamental principles of chemical process dynamics and feedback control. This includes open-loop dynamics of typical chemical engineering processes such as distillation, fluid flow, chemical reactors and heated stirred tanks. Closed-loop experiments will involve control loop design, controller tuning, multivariable, and computer control. Students will be required to design and execute their own experiments based on supplied objectives. Analysis and presentation of the results will be done through oral and written reports.

Department

Chemical Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

knowledge of fluid flow and heat transfer, mathematics and chemical engineering principles.

CHE 4410 : Chemical Process Safety Design

Application of chemical engineering design principles to the design of the process safety and environmental controls of a major chemical plant. Students work in groups to produce a preliminary practical flowsheet, equipment design and controls, and economic analysis, all associated with chemical process safety components within a plant. The course will also include an introduction to modeling of off-site impacts. This course meets the requirements for a core course and a Capstone Design course in chemical engineering. Students may not receive core credit for both CHE 4404 and CHE 4410.

Department

Chemical Engineering

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

familiarity with techniques and procedures of chemical engineering design (CHE 4403), working knowledge of thermodynamics, heat, mass and momentum transfer, inorganic and organic chemistry, chemical kinetics and reactor design.

Civil, Environmental & Architectural Engineering

CE 1030 : Civil Engineering and Computer Fundamentals

This course introduces students to basic fundamentals of civil engineering, group dynamics, oral presentation skills, engineering report writing techniques, and uses of the computer. Basics of structural engineering, geotechnical engineering, environmental engineering, surveying, materials, and construction engineering and management are presented in this course through a collaborative group teaching approach. Background is provided to gain competence in operating systems, editors, and spreadsheets. Student groups complete weekly computer laboratory projects and develop oral presentations and written reports.

Department

Civil, Environmental & Architectural Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

No previous computer use skills are required or assumed. This course is recommended for freshman or sophomore students.

CE 2000 : Analytical Mechanics I

This fundamental civil engineering course provides an introduction to the analysis of structures in static equilibrium. The focus of this course is a classical analysis of concurrent and non-concurrent equilibrium. A variety of engineering problems including trusses, machines, beams, rigid frames, and hydraulic structures involving concentrated and distributed loading systems are analyzed for external reactions and internal forces.

Department

Civil, Environmental & Architectural Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

CE 2001 : Analytical Mechanics II

This course provides an introduction to the relationship between analysis, design, and the behavior of materials under load. Theory and applications are developed that utilize simple and combined stress-strain behavior of members subjected to axial, torsional, and flexural loadings, with applications to beams, trusses, rigid frames, shafts, and tension and compression structures.

Department

Civil, Environmental & Architectural Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

CE 2000.

CE 2002 : Introduction to Analysis and Design

This course develops an understanding of classical and modern structural analysis. Topics include loading systems, and the analysis of statically determinate and statically indeterminate beams, frames, trusses, structural floor systems for buildings, bridges, and other structural assemblies.

Department

Civil, Environmental & Architectural Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

CE 2000 and CE 2001.

Suggested

CE 1030.

CE 2020 : Surveying

This course develops fundamental skills in the theoretical and practical aspects of plane surveying through the use and care of modern instruments and the associated computations. Topics include the classification of errors incurred in observed field data and necessary correction applications, the use and care of surveying equipment, traversing, differential leveling, stadia and mapping, and electronic data transfer. Computer applications are used where appropriate.

Department

Civil, Environmental & Architectural Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

CE 3006 : Design of Steel Structures

This course covers the theory and practice of structural steel design. The structural design process for beams, columns, trusses, frames, and connections is based on Load and Resistance Factor Design (LRFD) specifications of the American Institute of Steel Construction.

Department

Civil, Environmental & Architectural Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

CE 2002 and CE 3010.

Suggested

CE 1030.

CE 3008 : Design of Reinforced Concrete Structures

This course covers the theory and practice of reinforced concrete design. The structural design process for beams, columns, slabs, frames, flat slabs, footings, and retaining walls uses the ultimate strength design codes of the American Concrete Institute.

Department
Civil, Environmental & Architectural Engineering
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
CE 2002 and CE 3010.
Suggested
CE 1030.

CE 3010 : Structural Engineering

This course provides an understanding of the practice of structural engineering. It builds upon the fundamental skills developed in CE 2000, CE 2001, and CE 2002 to present the principles of structures and their elements. The course provides a perspective for dealing with the issues of strength, stiffness, and stability. Although wood is the principle material used to develop the study of the interrelationship between analysis and design of structural systems, structural steel and reinforced concrete systems are also discussed. It also introduces students to the use of building codes for design criteria. The role of the structural engineer in the design process and cost factors are also discussed.

Department
Civil, Environmental & Architectural Engineering
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
CE 2000, CE 2001, and CE 2002.
Suggested
CE 1030.

CE 3020 : Project Management

This course presents the fundamental concepts and process of project management applied to public and private works. The principle focus of the course is the management of civil engineering projects including planning, scheduling, organization and control, as well as management concepts of leadership, motivation, trust, project team development, division of work, and conflict resolution. Ancillary engineering and construction practices involving financial practices, construction documents, contract negotiation and administration, quality and safety control, insurance and bonding are covered.

Department
Civil, Environmental & Architectural Engineering
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
CE 1030.

CE 3022 : Legal Aspects of Professional Practice

The course focuses on the legal underpinnings that regulate the design and execution of construction projects and the relations between their participants. The subject is presented according to the various phases of a construction project, from inception to handover. The overall objective is to develop an awareness of the legal aspects that regulate the exercise of the architectural and civil engineering profession and of the environmental constraints of construction. Topics such as permitting process, design/engineering services and ethical issues are included. Some sections of this course may be offered as Writing Intensive (WI)

Department
Civil, Environmental & Architectural Engineering
Category
Category I (offered at least 1x per Year)
Units 1/3

CE 3025 : Project Evaluation

In this course students are provided with a systematic framework for evaluating the economic sustainability and financial aspects of a building investment through its life cycle: project definition, design, construction and operation. The course develops according to several interrelated topics: budgeting (square foot cost and parametric estimating) and economic feasibility analysis, financing mechanisms, cash flow analysis, (time-value -of -money factors, present worth and rate of return), life-cycle assessment (environmental impact analysis), taxes, depreciation and regulations as well as consideration of risks and uncertainties.

Department

Civil, Environmental & Architectural Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

AREN 2023.

CE 3026 : Materials of Construction

This course provides an understanding of the use and acquisition of engineering properties of construction materials. Topics include relationships between the structure of materials, their engineering properties, and the selection of suitable materials for applications involving strength, durability, and serviceability Experimental laboratory procedures including design of experiments, data collection, analysis, and representation, and report writing are an integral part of the work. Some sections of this course may be offered as Writing Intensive (WI).

Department

Civil, Environmental & Architectural Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

CE 1030 and CE 2001.

CE 3030 : Fundamentals of Civil Engineering Autocad

This course introduces Civil Engineering students to fundamental uses of the AutoCAD software package. Basic two dimensional drawing techniques are covered. Advanced topics that may be covered include three dimensional drawing, rendering and animation. Students are required to become familiar with AutoCAD.

Department

Civil, Environmental & Architectural Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Knowledge of the subject matter in at least two civil engineering design courses is expected background for this course.

CE 3031 : Building Information Modeling: Software Tools and Principles

This course introduces students to fundamental software applications for design and construction planning throughout the different phases of the development of civil engineering projects in a collaborative fashion as established by the principles of Building Information Modeling. The course covers the principles of basic 3D software environments, object creation and manipulation, assemblies of objects, surface and terrain modeling, building modeling, geographic and building information databases. Emphasis is given to the adaptability of this software to changes in design and to the production of graphic design documentation. Application software such as AutoCAD Civil 3D, Autodesk Revit and Navisworks are used in this course.

Department

Civil, Environmental & Architectural Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

CE 1030.

CE 3041 : Soil Mechanics

This is an introductory course dealing with the science and technology of earth materials with an emphasis on fundamental concepts of particulate mechanics. The topics which are discussed include fluid flow through porous media, deformation and shear characteristics of soil, consolidation, lateral earth pressure, and slope stability.

Department
Civil, Environmental & Architectural Engineering
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
CE 2000 and CE 2001.
Suggested
GE 2341.

CE 3044 : Foundation Engineering

Foundation engineering is a study of the applications of the principles of soil mechanics and structural theory to the analysis, design and construction of foundations for engineering works with the emphasis on the soil engineering aspects of soil structure interaction. Subsurface exploration techniques, design of rigid and flexible retaining structures, and design of, shallow and deep foundations are considered. Although the course deals mainly with aspects of the design of buildings and bridges, certain parts of the course (design of temporary trench bracing, for example) are very relevant to construction engineering.

Department
Civil, Environmental & Architectural Engineering
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
CE 3041.
Suggested
CE 3008.

CE 3050 : Traffic Engineering

This course provides an introduction to the field of transportation engineering with particular emphasis on traffic engineering. Principles, such as traffic studies, highway safety, traffic flow, intersection design and control, capacity analysis, and level of service analysis are included. In addition, basic highway design parameters associated with curves and sight distance are covered. Regional transportation systems and sustainable development are also discussed and analyzed; and concepts associated with parking, public transportation, and travel demand modeling are introduced.

Department
Civil, Environmental & Architectural Engineering
Category
Category I (offered at least 1x per Year)
Units 1/3

CE 3051 : Pavement Engineering

This course provides an introduction to concepts required for design construction and management of pavements. Topics include Highway Drainage, Soil Engineering for Highway Design, Bituminous Materials, Design of Flexible and Rigid Pavements and Pavement Management. Knowledge of the subject matter in CE 3050 is helpful but not required.

Department
Civil, Environmental & Architectural Engineering
Category
Category I (offered at least 1x per Year)
Units 1/3

CE 3059 : Environmental Engineering

This course provides an introduction to engineering aspects of environmental quality control. Students will learn fundamental science and engineering principles needed for environmental engineering, including concepts in chemistry, biology, physics, mass conservation, kinetics and reactor design. These principles are then applied to environmental engineering problems, including modeling of pollutants in natural systems and design of unit processes in engineered systems. Topics covered include environmental regulations, surface and ground water quality, drinking water treatment, wastewater treatment, air pollution, and hazardous waste management.

Department

Civil, Environmental & Architectural Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

college-level chemistry.

CE 3060 : Water Treatment

This course provides in-depth coverage of processes used in water treatment. Topics include: review of water chemistry and drinking water standards, impurities in natural waters, aeration, water softening coagulation, flocculation, sedimentation, filtration, disinfection, taste and odor control, corrosion control, and iron and manganese removal.

Department

Civil, Environmental & Architectural Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

CE 3059 and ES 3004.

CE 3061 : Sustainable Wastewater Engineering: Treatment and Reuse

This course provides an in-depth study of the theory and practice of sustainable wastewater management practices, including treatment operations and reuse opportunities. The course will incorporate resource recovery concepts involving water, nutrients, and energy. Topics include: sources of wastewater, wastewater characteristics, emerging contaminants, biosolids operations, wastewater reuse approaches, and physical, chemical, and biological processes for wastewater treatment and reuse.

Department

Civil, Environmental & Architectural Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

CE 3059 and ES 3004.

CE 3062 : Hydraulics

This course provides a background for applying the principles of fluid mechanics to analyze and design hydraulic and fluid flow systems for projects related to water resources and civil and environmental engineering. Topics include hydraulics in pipes and closed systems, open channels and rivers, water supply systems and water distribution networks, pump systems and turbines, wastewater collection and treatment systems, and coastal and other natural environmental systems. Course content includes water quality and energy considerations, as well as the development and application of hydraulic models.

Department

Civil, Environmental & Architectural Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

ES 3004.

CE 3070 : Urban and Environmental Planning

This course introduces to the student the social, economic, political, and environmental factors that affect the complex relationship between the built and natural environment. By using the principles of sustainable development and the procedures of planning, the optimal development pattern may be examined, and the infrastructure (roads, water supply systems, waste-water treatment systems, shopping malls, etc.) necessary to support present and future growth patterns may be determined. The information necessary in planning, which involves conscious procedures of analysis, formulation of alternative solutions, rational assessment and deliberate choice in accordance with evaluation criteria, is obtained through extensive reading. As such, the course introduces a variety of topics of concern to engineers and environmental scientists. The course is intended not only for civil engineering majors, but also for students preparing for an IQP in areas of urban or environmental concerns. Some sections of this course may be offered as Writing Intensive (WI).

Department

Civil, Environmental & Architectural Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

CE 3074 : Environmental Analysis

This course provides a background in the principles and techniques of assessing areas of natural environment and applying environmental assessments to evaluate the inherent suitability of these areas for sustainable urban and resource-based uses. Topic areas include basic concepts in sustainability, landscape characterization and analysis, and environmental impact assessment and planning. The concepts and techniques developed in this course are useful for land use planning, site design, natural resources management, and the determination of the impact of engineering projects on the environment.

Department

Civil, Environmental & Architectural Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Suggested

CE 3059 or CE 3070.

CE 4007 : Matrix Analysis of Structures

This course presents the principles of matrix analysis of structural elements and systems; fundamentals of matrix algebra, solution of simultaneous equations, matrix inversion; analysis of plane trusses, method of joints; displacement method, principle of virtual work, analysis of continuous beams, analysis of plane frames, plane trusses, analysis of building frames and bridges; computer aided structural analysis and principles of software development.

Department

Civil, Environmental & Architectural Engineering

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

CE 2002.

CE 4060 : Environmental Engineering Laboratory

In this course, students learn how to perform analytical methods and conduct laboratory experiments relevant to natural and engineered treatment systems in environmental engineering. Topics in water, wastewater, air, and environmental health are included. The course focuses on data acquisition, analysis, and interpretation as well as technical report writing.

Department

Civil, Environmental & Architectural Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

ES 3059, CE 3060, and CE 3061.

CE 4061 : Hydrology

This course introduces the concepts and principles governing the distribution and transport of water in the environment, and also provides a background for quantifying hydrologic processes as required for the development of water resources projects. Topics include the hydrologic cycle, precipitation, evaporation and transpiration, infiltration, runoff analysis, streamflow, hydrologic routing, statistics and probability in hydrology, and the quantification of hydrologic processes for water quality protection. The course introduces field techniques and the use of hydrologic models for solving problems in water resources and hydrology.

Department

Civil, Environmental & Architectural Engineering

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

ES 3004.

CE 4063/CHE 4063 : Transport & Transformations in the Environment

In this course, students will learn to make quantitative relationships between human activities and the effects on water, soil, and air in the environment. Students will learn the scientific and engineering principles that are needed to understand how contaminants enter and move in the environment, how compounds react in the environment, how to predict their concentrations in the environment, and how to develop solutions to environmental problems. Topics to be covered may include water quality engineering (including microbial interactions), air quality engineering, and hazardous waste management. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Civil, Environmental & Architectural Engineering

Chemical Engineering

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

Familiarity with transport phenomena, such as in ES 3004 (Fluid Mechanics) and ES 3002 (Mass Transfer), and familiarity with reaction kinetics and reactor design, such as through CHE 3201 (Kinetics and Reactor Design). Background such as CE 3059 (Environmental Engineering), CE 3060 (Water Treatment), or CE3061 (Wastewater Treatment) is suggested.

CE 4071 : Land Use Development and Controls

The purpose of this course is to provide an understanding of the regulatory framework under which land is developed and the built environment is designed. The quality of our environment depends upon the development which is permitted to take place and the controls which direct that development. Through this course, the student will learn the principles, methods, and techniques which a planner or engineer may use to plan and design the highest and best uses and development of land. In particular, the use and limits of zoning, special permits, subdivision control, and other tools with which a developer or planner should be familiar will be examined in detail. Some sections of this course may be offered as Writing Intensive (WI).

Department

Civil, Environmental & Architectural Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

CE 4600 : Hazardous and Industrial Waste Management

This course will cover concepts and techniques for handling hazardous and industrial wastes. Regulations governing hazardous waste, water & soil remediation concepts, and the fundamentals of waste treatment processes will be discussed. Instruction will be provided through lectures, fieldtrips, practitioner seminars, and class problem solving sessions. This course will be offered in 2021-22, and in alternating years thereafter.

Department

Civil, Environmental & Architectural Engineering

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

ES 3004 and CE 3059.

CE 4610 : Solid Waste Engineering

This course will provide an overview of municipal solid waste (MSW) engineering with specific attention to municipal solid waste quantities and characteristics, refuse collection systems, landfilling, recycling and material processing, pollution prevention, biological processing, and energy recovery.

Students may not receive credit for both CE 461X and CE 4610.

Department

Civil, Environmental & Architectural Engineering

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

Basic knowledge of general chemistry (CH 1010, CH 1020 or equivalent), differential equations (MA 2051 or equivalent), fluid mechanics (ES 3004 or equivalent), thermodynamics (ES 3001, or equivalent), and Environmental Engineering (CE 3059).

ENV 3500 : Women and the Environment

This course examines the perceived, existing, and potential links between women and the environment with an emphasis on the roles of women in environmental movements, climate change, climate justice, forest conservation, water management, disaster recovery, womenperceptions of environmental risk, and other environmental issues. Through reading, discussion, documentary films and research project, we will explore how social, economic, political and cultural systems that shape women's environmental experiences and their resistance and strategies for social change.

Department

Civil, Environmental & Architectural Engineering

Social Science & Policy Studies

Category

Category II (offered at least every other Year)

Units 1/3

Architectural Engineering

AREN 2002 : Architectural Design I

This course offers an introduction to the architectural design process by exploring the relations between materials, structures, spaces, and architectural composition. Studio: The studio design component explores the syntax of architecture, siting, context, and human scale. Students will engage these topics through architectural design studies for a project of limited scope and programmatic complexity. Hand drawing and sketching, modeling and visualization software, orthographic drawings, and physical models are used to explore, develop, and communicate architectural design concepts. Lectures / lab: The lecture/lab component of the course focuses on two-dimensional drawing techniques (including hand drawings and sketching), drawing conventions, and architectural representation techniques. Students are introduced to the fundamental uses of modeling software in engineering and architectural design practice. Advanced topics may include three dimensional modeling rendering, animation, and parametric design. This course uses studio, lecture, and lab based teaching methods

Department

Architectural Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

None

AREN 2004 : Architectural Design II - Light and Lighting Systems

This course aims to develop an understanding of the role of light and lighting in the perception of architecture and human well-being. Studio: The studio component of the course will explore the interactions between light, materials, spaces, and people. Students will engage these topics through architectural design studies for a project with well- specified lighting and architectural needs. Modeling, visualization and simulation software, orthographic drawings, and physical models are used to explore and analyze architectural design concepts. Lectures: The lecture components of the course focuses on the design of illumination systems in buildings. A general introduction to the visual environment is provided, including subjective and objective scales of measurement, visual perception, photometry, brightness, luminance, illumination, natural and artificial lighting. Other topics include photometric units, light sources, daylight luminaries, lighting quality, light loss factors, average luminance calculations (lumen method), point-by-point calculations, performance impacts, and ethics. Field measurements and computer simulations are used to explore some major aspects of architectural illumination systems. Design problems are solved by considering economic evaluation, energy saving criteria and applicable standards and building codes. Students will be introduced to the use of computer tools for the design, analysis, and visualization of natural and artificial lighting in buildings. This course uses studio and lecture based teaching methods Students may not receive credit for both AREN 2004 and AREN 3003

Department

Architectural Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Introductory architectural design (AREN 2002 or equivalent).

AREN 2023 : Introduction to Architectural Engineering Systems

The objective of this course is to introduce the functional parts and systems that make up a building as well as their interactions in delivering required sustainable performance. It encompasses foundations, structures, building enclosures, heating and air conditioning, electrical, plumbing and fire safety systems as well as concepts of building performance and aspects of pertinent building codes and standards. This course, in addition, incorporates basic principles of building science and green construction.

Department

Architectural Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

AREN 2025 : Building Electrical Systems

The principles of electrical system design in buildings are introduced in this course. Starting with an overview of electrical fundamentals and related laws, it covers circuit design, power distribution and service equipment, communication systems and special electrical systems that meet the requirements of the national electric code as well as building occupants. Other topics include single-phase and three-phase circuits, electrical and lighting loads, panel-board design, switching, system sizing, grounding, fault calculations, and over-current protection. The design criteria and calculation procedures for developing simple layouts of building electrical systems are illustrated. Work includes study of applicable NFPA 70 (NEC) and related building codes.

Department

Architectural Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

electricity and magnetism (PH 1120/1121 or equivalent)

AREN 3002 : Architectural Design III

This course aims to further a student's knowledge of the architectural design process through study of ideas, principles and methods of design and construction. Studio: Architectural concepts are developed with the completion of a project of expanded scope and complexity. The course emphasizes the development of form, space, spatial relationships, materials, context, program, and architectural presentation techniques. Hand drawing and sketching, modeling and visualization software, orthographic drawings, detail drawings, and physical models are used to explore, develop, and communicate architectural design concepts. Lectures: The lecture/lab component of the course focuses on three-dimensional modeling and architectural representation techniques. Students are introduced to advanced modeling software in engineering and architectural design practice. Topics include three dimensional modeling, rendering, animation, and parametric design. This course uses studio, lecture, and lab based teaching methods

Department

Architectural Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Intermediate architectural design (AREN 2002 and AREN 2004 or equivalent)

AREN 3003 : Principles of HVAC Design for Buildings

The course introduces principles and applications of mechanical systems that are required for environmental comfort, health, and safety of building occupants with a focus on energy efficiency and conservation. Topics include psychometrics, thermal comfort, building heating and cooling loads, fluid flow basics, HVAC components and systems, building envelop heat transfer, and energy requirements. In the course, students develop the ability to design and conduct computational modelling experiments and to analyze and interpret output data for selection between system alternatives in order to optimize energy use. Some sections of this course may be offered as Writing Intensive (WI)

Department

Architectural Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Thermodynamics.

AREN 3005 : Lighting Systems

This course focuses on the design of illumination systems in buildings. It provides a general introduction to the visual environment, including subjective and objective scales of measurement, visual perception, photometry, brightness, luminance, illumination, natural and artificial lighting. Other topics include photometric units, light sources, daylight luminaries, lighting quality, light loss factors, average luminance calculations (lumen method), point-by-point calculations, performance impacts, and ethics. Field measurements and computer simulations are used to explore some major aspects of architectural illumination systems. Design problems are solved by considering economic evaluation, energy saving criteria and applicable standards and building codes.

Department

Architectural Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

electrical systems (AREN 2025 or equivalent)

AREN 3006 : Advanced HVAC System Design

Analysis of heating and cooling load requirements, considering building construction type, geometry, infiltration, occupancy effects, and daily load variations. Heating design addresses water heating systems, electrical heating, central heating, heating of low and high-rise buildings, selection of heaters, boilers, pumps, piping design. Cooling design addresses refrigerants, refrigeration cycle, evaporator, compressor, condenser, thermostatic expansion valves, refrigeration system control equipment, motor and motor control equipment, refrigeration accessories, calculation of refrigeration piping and absorption systems. Computer applications for heating and cooling load analysis will be introduced to develop energy saving solutions. Analytical techniques and building codes are discussed through case studies and design projects.

Department

Architectural Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

AREN 3003, ES 3004.

AREN 3020 : Architectural Design IV - Building Energy Simulation

This course aims to develop an understanding of sustainability in architecture and introduces the fundamentals and applications of energy simulation tools. Studio: The studio component of the course will explore the relationships between people, buildings, and the environment. Students will explore the impact of building site and context, orientation, building massing and envelop configuration, occupancy and other factors. Students will engage these topics through architectural design studies and simulations for a project of increased scope and programmatic complexity. Modeling and visualization software, simulation tools, orthographic drawings, and physical models are used to explore and develop architectural design concepts. Lectures: The lecture components of the course focuses on the principles of building energy simulation, with a focus on the practical applications of building energy simulation tools to building design. Topics being covered include various model input parameters such as building geometry, orientation, climate, comfort, zoning, material properties, operation schedules, and HVAC systems. Building energy simulation software is illustrated and applied to the analysis of case studies and/or design projects. Simulation output results are critically analyzed and compared to the results obtained from other building energy calculation methods. This course uses studio and lecture based teaching methods Students may not receive credit for both AREN 3020 and AREN 3023

Department

Architectural Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Building Physics and HVAC system design (AREN 3024 and AREN 3003) and Architectural Design (AREN 2002, AREN 2004, and AREN 3002 or equivalent).

AREN 3022 : Architectural Design V - Building Envelope Design

This course aims to develop an understanding of the architectural design development process with special focus on the design and detailing of building envelopes. Studio: Through an iterative process, students will advance the architectural and technical development of an architectural project of increased complexity. Modeling and simulation software, orthographic drawings, detail drawings, and physical models are used to advance the development of architectural design concepts. Lectures: The lecture component of the course covers the basic principles of building envelope design, focusing primarily on functional performance requirements and practical constructability aspects. Various building envelope systems are reviewed, including facade and roofing systems made of masonry, stone, concrete, timber, glass, and various metals. More elaborate building envelope strategies will also be reviewed; such as double skin facades and passive solar design approaches. Students will be introduced to computer tools and other methods for the analysis of heat and moisture transfer within building envelopes and components thereof. This course uses studio and lecture based teaching methods Students may not receive credit for both AREN 3022 and AREN 3026

Department

Architectural Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Building Physics and HVAC system design (AREN 3024 and AREN 3003) and Architectural Design (AREN 2002, AREN 2004, and AREN 3002 or equivalent).

AREN 3024 : Building Physics

The course introduces the principles of building physics, as they are applied to various building design situations and performance requirements. Covered topics include heat transfer, moisture control, condensation, cold bridging, external and internal gains, and air flows, as they pertain to building envelopes (external walls, windows and doors, and roofs) and the requirements of environmental comfort of space occupants. Design exercises take into account pertinent building and energy codes as well as comfort standards. The course gives students the tools to integrate engineering science fundamentals and physics principles in developing building design solutions. Thermal measurements in building components are performed.

Department

Architectural Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

thermodynamics and heat transfer (ES 3001, ES 3003 or equivalent).

AREN 3025 : Building Energy Simulation

The course addresses the basic principles of building energy simulation, with a focus on the practical applications of building energy simulation tools to building design. Topics being covered include various model input parameters such as building geometry, orientation, climate, comfort, zoning, material properties, operation schedules, and HVAC systems. Building energy simulation software packages are illustrated and applied to the analysis of various case studies of buildings. Simulation output results are critically analyzed and compared to the results obtained from other building energy calculation methods.

Department

Architectural Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Building physics (AREN 3024 or equivalent)

Electrical and Computer Engineering

BME 4011/ECE 4011 : Biomedical Signal Analysis

Introduction to biomedical signal processing and analysis. Fundamental techniques to analyze and process signals that originate from biological sources: ECGs, EMGs, EEGs, blood pressure signals, etc. Course integrates physiological knowledge with the information useful for physiologic investigation and medical diagnosis and processing. Biomedical signal characterization, time domain analysis techniques (transfer functions, convolution, auto- and cross-correlation), frequency domain (Fourier analysis), continuous and discrete signals, deterministic and stochastic signal analysis methods. Analog and digital filtering. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Biomedical Engineering
Electrical and Computer Engineering

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

ECE 2311, ECE 2312, or equivalent.

BME 4023/ECE 4023 : Biomedical Instrumentation Design

This course builds on the fundamental knowledge of instrumentation and sensors. Lectures cover the principles of designing, building and testing analog instruments to measure and process biomedical signals. The course is intended for students interested in the design and development of electronic bioinstrumentation. Emphasis is placed on developing the student's ability to design a simple medical device to perform real-time physiological measurements.

Department

Biomedical Engineering
Electrical and Computer Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

BME 3012, BME 3013, ECE 2010 or ECE 2019.

CS 4801/ECE 4802 : Introduction to Cryptography and Communication Security

This course provides an introduction to modern cryptography and communication security. It focuses on how cryptographic algorithms and protocols work and how to use them. The course covers the concepts of block ciphers and message authentication codes, public key encryption, digital signatures, and key establishment, as well as common examples and uses of such schemes, including the AES, RSA-OAEP, and the Digital Signature Algorithm. Basic cryptanalytic techniques and examples of practical security solutions are explored to understand how to design and evaluate modern security solutions. The course is suited for students interested in cryptography or other security related fields such as trusted computing, network and OS security, or general IT security.

Department

Computer Science
Electrical and Computer Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Experience in expressing algorithms in a modern programming language (e.g., ECE 2049 or CS 2301). ECE 2049 (Embedded Computing in Engineering Design) or CS 2301 (Systems Programming for Non-Majors) or equivalent.

Suggested

Discrete mathematics (CS 2022/MA 2201 or equivalent)

ECE 1799 : Frontiers and Current Issues of Electrical and Computer Engineering

This is a seminar-based course intended for First Year students seeking to understand the breadth of activities, career choices and technology that are considered to comprise Electrical and Computer Engineering. Students considering ECE as a major, both those who are "decided" as well as those who are "undecided" should enroll in ECE 1799. The class meets once a week during the fall semester (A & B terms). Note: There are no "recommended" or "suggested" courses for this description.

Department

Electrical and Computer Engineering

Category

Category I (offered at least 1x per Year)

Units 1/6

ECE 2010 : Introduction to Electrical and Computer Engineering

The objective of this course is to introduce students to the broad field of electrical and computer engineering within the context of real world applications. This course is designed for first-year students who are considering ECE as a possible major or for non-ECE students fulfilling an out-of-major degree requirement. The course will introduce basic electrical circuit theory as well as analog and digital signal processing methods currently used to solve a variety of engineering design problems in areas such as entertainment and networking media, robotics, renewable energy and biomedical applications. Laboratory experiments based on these applications are used to reinforce basic concepts and develop laboratory skills, as well as to provide system-level understanding. Circuit and system simulation analysis tools are also introduced and emphasized. Topics: Basic concepts of AC/DC and Digital electrical circuits, power, linear circuit simulation and analysis, op-amp circuits, transducers, feedback, circuit equivalents and system models, first order transients, the description of sinusoidal signals and system response, analog/digital conversion, basic digital logic gates and combinatorial circuits.

Department

Electrical and Computer Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

high school physics, and MA 1022 (concurrent).

ECE 2019 : Sensors, Circuits, and Systems

This course investigates commonly used sensors such as resistive temperature sensors, capacitive touch sensors, and inductive motion sensors and actuators. Numerous applications are presented to motivate coverage of fundamental operating principles of circuit elements such as resistors, capacitors, and inductors; model the signals produced by these sensors; and analyze the circuits and systems used to amplify and process these signals. After a review of Kirchhoff 's current and voltage laws, fundamental analysis techniques such as Thevenin and Norton's theorems and the superposition principle are used to model and analyze sensors, circuits, and systems. Concepts from analysis of linear, time-invariant continuous-time signals and systems are introduced as necessary, including Fourier series and characterization of systems such as filters in both the frequency domain (bandwidth, transfer function) and time domain (rise time, step response). Capacitance, inductance and mutual inductance are explored as energy storage elements, including consideration of resonance and energy losses in power systems. Concepts will be reinforced with the use of laboratory exercises and computer simulation. Note: Students who have received credit for ECE 2111 may not receive credit for ECE 2019.

Department

Electrical and Computer Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

ECE 2010, MA 1024 (or equivalent), PH 1120/21 and MA 2051 (concurrent).

ECE 2029 : Introduction to Digital Circuit Design

Digital circuits are the foundation upon which the computers, cell phones, and calculators we use every day are built. This course explores these foundations by using modern digital design techniques to design, implement and test digital circuits ranging in complexity from basic logic gates to state machines that perform useful functions like calculations, counting, timing, and a host of other applications. Students will learn modern design techniques, using a hardware description language (HDL) such as Verilog to design, simulate and implement logic systems consisting of basic gates, adders, multiplexers, latches, and counters. The function and operation of programmable logic devices, such as field programmable gate arrays (FPGAs), will be described and discussed in terms of how an HDL logic design is mapped and implemented. Experiments involving the design of combinational and sequential circuits will provide students a hands-on introduction to basic digital electrical engineering concepts and the skills needed to gain more advanced skills. In the laboratory, students will construct, troubleshoot, and test the digital circuits that they have developed using a hardware description language. These custom logic designs will be implemented using FPGAs and validated using test equipment. Topics: Number representations, Boolean algebra, design and simplification of combinational circuits, arithmetic circuits, analysis and design of sequential circuits, and synchronous state machines. Lab exercises: Design, analysis and construction of combinational and sequential circuits; use of hardware description languages to implement, test, and verify digital circuits; function and operation of FPGAs. Note: Students who have received credit for ECE 2022 may not receive credit for ECE 2029.

Department

Electrical and Computer Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Introductory Electrical and Computer Engineering concepts covered in a course such as ECE 2010 or RBE 1001, and MA 1022.

ECE 2049 : Embedded Computing in Engineering Design

Embedded computers are literally everywhere in modern life. On any given day we interact with and depend on dozens of small computers to make coffee, run cell phones, take pictures, play music play, control elevators, manage the emissions and antilock brakes in our automobile, control a home security system, and so on. Using popular everyday devices as case studies, students in this course are introduced to the unique computing and design challenges posed by embedded systems. Students will then solve real-world design problems using small, resource constrained (time/memory/power) computing platforms. The hardware and software structure of modern embedded devices and basic interactions between embedded computers and the physical world will also be covered in lecture and as part of laboratory experiments. In the laboratory, emphasis is placed on interfacing embedded processors with common sensors and devices (e.g. temperature sensors, keypads, LCD display, SPI ports, pulse width modulated motor controller outputs) while developing the skills needed to use embedded processors in systems design. This course is also appropriate for RBE and other engineering and CS students interested in learning about embedded system theory and design. Topics: Number/data representations, embedded system design using C, microprocessor and microcontroller architecture, program development and debugging tools for a small target processor, hardware/software dependencies, use of memory mapped peripherals, design of event driven software, time and resource management, applications case studies. Lab Exercises: Students will solve commonly encountered embedded processing problems to implement useful systems. Starting with a requirements list students will use the knowledge gained during the lectures to implement solutions to problems which explore topics such as user interfaces and interfacing with the physical world, logic flow, and timing and time constrained programming. Exercises will be performed on microcontroller and/or microprocessor based embedded systems using cross platform development tools appropriate to the target platform. Note: Students who have received credit for ECE 2801 may not receive credit for ECE 2049.

Department

Electrical and Computer Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

ECE 2010 or equivalent knowledge in basic circuits, devices and analysis; and C language programming (CS 2301 or equivalent) Suggested Background: ECE 2029 or equivalent knowledge of digital logic, logic signals and logic operations;

ECE 2112 : Electromagnetic Fields

The object of this course is a comprehensive treatment of electromagnetic engineering principles covering the entire application spectrum from static to dynamic field phenomena. The starting point will be the basic electric and magnetic field definitions of Coulomb and Biot-Savart leading to Gauss's and Ampere's laws. They form the foundation of electro- and magnetostatics fields. Students will examine capacitive and inductive systems and relate them to lumped element circuit models. By introducing temporal and spatial magnetic flux variations, Faraday's law is established. The engineering implications of this law are investigated in terms of transformer and motor actions. Incorporation of the displacement current density into Ampere's law and combining it with Faraday's law will then culminate in the complete set of Maxwell's field equations. As a result of these equations, students will develop the concept of wave propagation in the time and frequency domain with practical applications such as wireless communication, radar, Global Positioning Systems, and microwave circuits.

Department

Electrical and Computer Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

ECE 2019.

ECE 2201 : Microelectronic Circuits I

This course is the first of a two-course sequence in electronic circuit design. It begins with a substantive treatment of the fundamental behavior of semiconductor materials and moves on to the semiconductor diode, the bipolar transistor, and the field-effect transistor. Laboratory exercises are provided to reinforce the theory of operation of these devices. Numerous circuit applications are considered, including: power supplies, transistor amplifiers, and FET switches. Topics include: the pn junction, diode operation, transducers, rectification, voltage regulation, limiting and clamping circuits, transistor operation, biasing, small-signal and large-signal models, transistors amplifiers, and switching applications.

Department

Electrical and Computer Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

ECE 2019.

ECE 2305 : Introduction to Communications and Networks

This course provides an introduction to the broad area of communications and networking, providing the context and fundamental knowledge appropriate for all electrical and computer engineers, as well as for further study in this area. The course is organized as a systems approach to communications and networking. Topics include key concepts and terminology (delay, loss, throughput, bandwidth, etc.), types of transmission media, addressing, switching, routing, networking principles and architectures, networking protocols, regulatory and applications issues.

Department

Electrical and Computer Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

ECE 2010.

ECE 2311 : Continuous-Time Signal and System Analysis

This course provides an introduction to time and frequency domain analysis of continuous time signals and linear systems. Topics include signal characterization and operations; singularity functions; impulse response and convolution; Fourier series; the Fourier transform and its applications; frequency-domain characterization of linear, time-invariant systems such as filters; and the Laplace transform and its applications.

Department

Electrical and Computer Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

MA 2051, ECE 2019, and a prior course in computer programming such as CS 2301 or CS 1101/2/4.

ECE 2312 : Discrete-Time Signal and System Analysis

This course provides an introduction to the time and frequency domain analysis of discrete-time signals and linear systems. Topics include sampling and quantization, characterization of discrete-time sequences, the discrete-time Fourier transform, the discrete Fourier transform and its applications, the Z transform and its applications, convolution, characterization of FIR and HR discrete-time systems, and the analysis and design of discrete-time filters. The course will include a focus on applications such as sampling and quantization, audio processing, navigation systems, and communications. Extensive use will be made of simulation tools including Matlab.

Department

Electrical and Computer Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

MA 2051, ECE 2311, and a prior course in computer programming such as CS 2301 or CS 1101/2/4.

ECE 2799 : Electrical and Computer Engineering Design

The goal of this course is to provide experience with the design of a system, component, or process. Basic sciences, mathematics, and engineering sciences are applied to convert resources to meet a stated objective. Fundamental steps of the design process are practiced, including the establishment of objectives and criteria, synthesis, analysis, manufacturability, testing, and evaluation. Student work in small teams and are encouraged to use creativity to solve specific but open-ended problems, and then present their results. ECE 2799 is strongly recommended for all students as a preparation for the design element of the MQP. It is anticipated that ECE 2799 will be of most benefit to students when taken well in advance of the MQP (late sophomore year or early junior year).

Department

Electrical and Computer Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

At least three of ECE 2019, ECE 2029, ECE 2049, ECE 2311.

ECE 3012 : Introduction to Control Systems Engineering

This course provides an introduction to the analysis and design of continuoustime control systems. Topics covered in the course include: modeling in the frequency and time domain, characteristics of control systems time response, reduction of multiple subsystems, analysis of systems transient response, stability, steady-state errors, root locus techniques, design of PI, PD, and PID controllers via root locus, frequency response techniques, and design via frequency response. The course will not have a formal laboratory. It will include projects which will require the use of software such as MATLAB, Simulink, or Lab VIEW for analysis and design of control systems. Students may not receive credit for both ES 3011 and ECE 3012.

Department

Electrical and Computer Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Ordinary Differential Equations (MA 2051), Sensors, Circuits, and Systems (ECE 2019), and Continuous-time Signal and System Analysis (ECE 2311).

ECE 3113 : Introduction to RF Circuit Design

This course is designed to provide students with the basic principles of radio frequency (RF) circuit design. It concentrates on topics such as designing tuning and matching networks for analog and digital communication, satellite navigation, and radar systems. After reviewing equivalent circuit representations for RF diodes, transistors, FETs, and their input/output impedance behavior, the course examines the difference between lumped and distributed parameter systems. Characteristics impedance, standing waves, reflection coefficients, insertion loss, and group delay of RF circuits will be explained. Within the context of Maxwell's theory the course will then focus on the graphical display of the reflection coefficient (Smith Chart) and its importance in designing matching circuits. Students will learn the difference between SPICE and monolithic and microwave integrated circuit analysis, and design (MMICAD) modeling. Biasing and matching networks for single and multistage amplifiers in the 900 to 2,000 MHz range are analyzed and optimized in terms of input/output impedance matching, insertion loss, and groups delays.

Department

Electrical and Computer Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

ECE 2019, ECE 3204.

Suggested

ECE 2112.

ECE 3204 : Microelectronic Circuits II

This course is the second of a two-course sequence in electronic circuit design. More complex circuits are analyzed and the effects of frequency and feedback are considered in detail. The course provides a comprehensive treatment of operational amplifier operation and limitations. The use of Bode plots to describe the amplitude and phase performance of circuits as a function of operating frequency is also presented. In addition, the concepts of analog signal sampling, analog-to-digital conversion and digital-to-analog conversion are presented along with techniques for interfacing analog and digital circuitry. Laboratory exercises are provided to reinforce student facility with the application of these concepts to the design of practical circuits. Topics include: transducers; differential amplifiers, inverting/non-inverting amplifiers, summers, differentiators, integrators, passive and active filers, the Schmitt trigger, monostable and a-stable oscillators, timers, sample-and-hold circuits, A/D converters, and D/A converters.

Department

Electrical and Computer Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Introductory electronic-circuit design and analog-signal analysis as found in ECE 2201 and ECE 2311.

ECE 3308 : Introduction to Wireless Networks

This course is intended for students interested in obtaining a systems-level perspective of modern wireless networks. It starts with an overall understanding of telecommunication and computer communication networks. Then the fundamental theory of operation of wireless networks as well detailed description of example networks will be covered. Topics included in the course are an overview of computer networks, an overview of wireless network standards and products, radio channel modeling and medium access control, deployment of wireless infrastructures, and examples of voice- and data-oriented wireless networks using TDMA, CDMA, and CSMA access methods. With extra work, this course can be successfully completed by non-ECE students; basic concepts of radio propagation, transmission, and medium access control will be introduced as needed.

Department

Electrical and Computer Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

MA 1022 and PH 1120.

Suggested

ECE 2312 and ECE 2303.

ECE 3311 : Principles of Communication Systems

This course provides an introduction to analog and digital communications systems. The bandpass transmission of analog data is motivated and typical systems are analyzed with respect to bandwidth considerations and implementation techniques. Baseband and passband digital transmission systems are introduced and investigated. Pulse shaping and intersymbol interference criteria are developed in relation to the pulse rate transmission limits of bandlimited channels. Finally, digital carrier systems and line coding are introduced in conjunction with applications to modern modem transmission schemes.

Department

Electrical and Computer Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

MA 1024 and ECE 2312.

Suggested

ECE 2305.

ECE 3500 : Electric Power and Renewable Energy Systems

Concepts integral to the generation, transmission, storage, and use of electrical power are introduced with particular emphasis on economic, environmental, and regulatory influences that have shaped the structure of our power grid for over 100 years. Power generators, including those powered by traditional fossil fuels and renewable sources, are covered, providing a background of technology evolution that leads to distributed energy resources (DERs), energy storage systems, and smart grid solutions. Three-phase lines, loads, and generators are discussed together with the need for power factor calculation and correction. Construction and performance of high voltage transmission lines is introduced. Power flow analysis across a power network from generation to transmission to consumption is provided and modeled, including consideration of basic faults at various points in the network. Methods of energy storage are considered together with basic power grid protection techniques. These technologies converge toward the construction of robust smart grids that employ advanced data analytics and communications for real-time fault identification, load balancing, and correction.

Department

Electrical and Computer Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Recommended background: ECE 2010

ECE 3501 : Electromechanical Energy Systems

The duality of electromechanical systems, which may be used to either generate or consume electrical power, is studied through examination of methods and machines that enable energy conversion to occur. The analysis and design of systems that employ coupled magnetic fields to convert electrical to mechanical energy and vice versa is explored using fundamental electromagnetic concepts, AC/DC systems analysis, and numerical simulation. Generator and motor machine components are modeled using magnetic circuits to demonstrate energy flow. Electric transformers are carefully considered to understand voltage and current conversion with corresponding device power losses. The principles of rotating single and polyphase systems are covered with application examples ranging from micro to industrial scale. AC/DC motors and generators are explored through a review of their physical construction, equivalent circuits, and performance characteristics. Power factor and power factor correction are examined to enable greater system efficiency. Special emphasis is given to synchronous machines, which comprise most of modern power generation, and induction machines, which are used in a myriad of everyday applications. This course includes simulations of motors and generators with some circuit analysis using circuit simulators, project work, and selected power system demonstrations.

Department

Electrical and Computer Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

ECE 3500.

Suggested

ECE 2019, ECE 2112, and ECE 2311.

ECE 3829 : Advanced Digital System Design with FPGAs

This course covers the systematic design of advanced digital systems using FPGAs. The emphasis is on top-down design starting with high level models using a hardware description language (such as VHDL or Verilog) as a tool for the design, synthesis, modeling, test bench development, and testing and verification of complete digital systems. These types of systems include the use of embedded soft core processors as well as lower level modules created from custom logic or imported IP blocks. Interfaces will be developed to access devices external to the FPGA such as memory or peripheral communication devices. The integration of tools and design methodologies will be addressed through a discussion of system on a chip (SOC) integration, methodologies, design for performance, and design for test. Topics: Hardware description languages, system modeling, synthesis, simulation and testing of digital circuits; Design integration to achieve specific system design goals including architecture, planning and integration, and testing; Use of soft core and IP modules to meet specific architecture and design goals. Laboratory exercises: Students will design and implement a complete sophisticated embedded digital system on an FPGA. HDL design of digital systems including lower level components and integration of higher level IP cores, simulating the design with test benches, and synthesizing and implementing these designs with FPGA development boards including interfacing to external devices. Students who have received credit for ECE 3810 may not receive credit for ECE 3829.

Department

Electrical and Computer Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

ECE 2029 and ECE 2049

ECE 3849 : Real-Time Embedded Systems

This course continues the embedded systems sequence by expanding on the topics of real-time software and embedded microprocessor system architecture. The software portion of this course focuses on solving real-world problems that require an embedded system to meet strict real-time constraints with limited resources. On the hardware side, this course reviews and expands upon all the major components of an embedded microprocessor system, including the CPU, buses, memory devices and peripheral interfaces. New IO standards and devices are introduced and emphasized as needed to meet system design, IO and performance goals in both the lecture and laboratory portion of the course. Topics: Cross-compiled software development, embedded system debugging, multitasking, real-time scheduling, inter-task communication, software design for deterministic execution time, software performance analysis and optimization, device drivers, CPU architecture and organization, bus interface, memory management unit, memory devices, memory controllers, peripheral interfaces, interrupts and interrupt controllers, direct memory access. Laboratory exercises: Programming real-time applications on an embedded platform running a real-time operating system (RTOS), configuring hardware interfaces to memory and peripherals, bus timing analysis, device drivers.

Department

Electrical and Computer Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

ECE 2029 and ECE 2049.

ECE 4305 : Software-Defined Radio Systems and Analysis

This course provides students with hands-on exposure to the design and implementation of modern digital communication systems using software-defined radio technology. The prototyping and real-time experimentation of these systems via software-defined radio will enable greater flexibility in the assessment of design trade-offs as well as the illustration of "real world" operational behavior. Performance comparisons with quantitative analytical techniques will be conducted in order to reinforce digital communication system design concepts. In addition to laboratory modules, a final course project will synthesize topics covered in class. Course topics include software-defined radio architectures and implementations, digital signaling and data transmission analysis in noise, digital receiver structures (matched filtering, correlation), multicarrier communication techniques, radio frequency spectrum sensing and identification (energy detection, matched filtering), and fundamentals of radio resource management.

Department

Electrical and Computer Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

ECE 3311, MA 2621, familiarity with Simulink, familiarity with general programming.

ECE 4503 : Power Electronics And Power Management

The availability of electric power in a variety of forms is integral to modern society. Very often, electric power must be converted from one form to another to meet a specific application need – this conversion process is accomplished through the use and efficient management of power electronics. Design of power electronics is introduced first by examining the performance characteristics of basic switching devices, which enable critical management functions that include pulse width modulation (PWM) and output power regulation. Half and full-wave AC source rectification and techniques for improving the resulting DC power characteristics are covered, including polyphase AC sources. AC voltage control with applications for induction motors is studied. DC-DC power conversion is examined, covering a variety of circuit architectures, with applications in feedback control. DC to AC power inversion and resulting power quality considerations are explored. The impacts of design decisions on power electronics systems, from micro- to megawatts, are demonstrated through numerical simulation. This course includes guest lectures, project work including case-studies and selected power system demonstrations.

Department

Electrical and Computer Engineering

Units 1/3

Recommended Background

ECE 3204, ECE 3501. Student who has previously received credit for ECE 3503 may not receive credit for ECE 4503.

ECE 4703 : Real-Time Digital Signal Processing

This course provides an introduction to the principles of real-time digital signal processing (DSP). The focus of this course is hands-on development of real-time signal processing algorithms using audio-based DSP kits in a laboratory environment. Basic concepts of DSP systems including sampling and quantization of continuous time signals are discussed. Tradeoffs between fixed-point and floating-point processing are exposed. Real-time considerations are discussed and efficient programming techniques leveraging the pipelined and parallel processing architecture of modern DSPs are developed. Using the audio-based DSP kits, students will implement real-time algorithms for various filtering structures and compare experimental results to theoretical predictions.

Department

Electrical and Computer Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

ECE 2049, ECE 2312, some prior experience in C programming.

Suggested

ECE 3311.

ECE 4801 : Computer Organization and Design

This course focuses on the computer organization and architectural design of standalone embedded and high-performance microprocessor systems. This course covers performance metrics, machine level representation of information, the assembly level interface, memory system organization and architecture, computer input/output, instruction set architecture (ISA) design, single cycle and multicycle CPU datapath and controlpath design as well as more advanced level topics such as pipelining, interrupts, cache and memory system design. Special attention will be paid into measuring architectural performance and into improving computer architectures at various levels of the design hierarchy to reach optimal performance. The course will include several hands-on projects and laboratory components where students will be required to perform simulations of CPU designs using architectural simulation tools such as MIPS Simulators and SimpleScalar.

Department

Electrical and Computer Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

ECE 3849

Suggested

ECE 3829

ECE 4902 : Analog Integrated Circuit Design

This course introduces students to the design and analysis of analog integrated circuits such as operational amplifiers, phase-locked loops, and analog multipliers. Topics: integrated circuit building blocks: current mirrors and sources, differential amplifiers, voltage references and multipliers, output circuits. Computer-aided simulation of circuits. Layout of integrated circuits. Design and analysis of such circuits as operational amplifiers, phase-locked loops, FM detectors, and analog multipliers. Laboratory exercises. This course will be offered in 2021-22, and in alternating years thereafter.

Department

Electrical and Computer Engineering

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

familiarity with the analysis of linear circuits and with the theory of bipolar and MOSFET transistors. Such skills are typically acquired in ECE 3204.

Suggested

ECE 4904.

ECE 4904 : Semiconductor Devices

The purpose of this course is to introduce students to the physics of semiconductor devices and to show how semiconductor devices operate in typical linear and nonlinear circuit applications. This material complements the electronics sequence of courses and will draw illustrative examples of electronic circuit applications from other courses. Topics: carrier transport processes in semiconductor materials. Carrier lifetime. Theory of p-n junctions. Bipolar transistors internal theory, dc characteristics, charge control, Ebers-Moll relations; high frequency and switching characteristics, hybrid-pi model; n- and p-channel MOSFETS, CMOS. Students who have received credit for ECE 3901 may not receive credit for ECE 4904. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Electrical and Computer Engineering

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

ECE 2201. Suggested background: ECE 3204 (helpful but not necessary).

Fire Protection Engineering

FP 3070 : Introduction to Fire Protection Engineering

This course teaches students of different technical disciplines the fundamentals of fire protection engineering including combustion chemistry, fire behavior, compartment fire dynamics, toxicity, human behavior in fire, and fire modelling. Students have an opportunity to conduct and view fire experiments in both the WPI Fire Safety Engineering and the WPI Fire Fundamentals laboratories. Fire models are used to aid in use of the scientific method to determine cause and origin of a fire. This course is intended for both majors and non-majors as an introduction into Fire Protection Engineering (FPE) and how engineering knowledge can be used to save lives and property around the world.

Department

Fire Protection Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

FP 3080 : Introduction to Building Fires Safety System Design

This course introduces principles and applications of building fire safety design. Topics include the interaction between fire, the building, and building occupants; systems that are used to detect, suppress, and control the spread of fire; and systems that facilitate the safe evacuation of occupants during fire. Building code requirements and engineering methods for analysis and design of building fire safety systems will be explored.

Department

Fire Protection Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

ES 3001 Thermodynamics

FP 4000 : Fire Laboratory

This course will cover experimental methods used in fire research as well as other thermal-fluid topic areas. Students will learn fundamentals of metrology (calibration, sensor response constraints, uncertainty quantification), standard tests in fire research (i.e. cone calorimeter, fire propagation apparatus, etc.), as well as other measurement methods (thermocouples, heat flux gauges, velocimetry, thermometry, etc.). Students will also learn design of experiments and conduct a large-scale experiment in the UL performance lab.

Department

Fire Protection Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

ES 3001 Thermodynamics

FP 4001 : Fire, Risk, and Sustainability

As the pace of development increases around the world, fire prevention and control are becoming more vital for individuals, organizations, and society itself. This course introduces students to the fundamental concepts of fire risk and sustainability along with related multi-disciplinary topics such as economics, human behavior, and decision-making. The process of fire risk assessment is taught and applied to the built environment and to the wildland fire problem. Students will undertake a structured applied-research project (individually or in small groups) to develop sustainable solutions at the interface of fire and a chosen area of sustainability such as climate change, safe drinking water, public health, housing, and more.

Department

Fire Protection Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Basic knowledge of fire behavior and control (FP 3070 or equivalent). Students cannot receive credit for both FP 4001 and FP 580S – Fire, Risk and Sustainability.

Robotics Engineering

RBE 1001 : Introduction to Robotics

Multidisciplinary introduction to robotics, involving concepts from the fields of electrical engineering, mechanical engineering and computer science. Topics covered include sensor performance and integration, electric and pneumatic actuators, power transmission, materials and static force analysis, controls and programmable embedded computer systems, system integration and robotic applications. Laboratory sessions consist of hands-on exercises and team projects where students design and build mobile robots. Undergraduate credit may not be earned for both this course and for ES 2201.

Department
Robotics Engineering
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
CS 1004 or significant experience with programming in python. PH 1120 or PH 1121.

RBE 2001 : Unified Robotics I: Actuation

First of a four-course sequence introducing foundational theory and practice of robotics engineering and the application of concepts from the fields of computer science, electrical engineering and mechanical engineering to the design of robots. The focus of this course is the effective conversion of electrical power to mechanical power, and power transmission for purposes of locomotion, and of payload manipulation and delivery. Concepts of energy, power and kinematics will be applied. Concepts from statics such as force, moments and friction will be applied to determine power system requirements and structural requirements. Simple dynamics relating to inertia and the equations of motion of rigid bodies will be considered. Power control and modulation methods will be introduced through software control of existing embedded processors and power electronics. The necessary programming concepts and interaction with simulators and Integrated Development Environments will be introduced. Laboratory sessions consist of hands-on exercises and team projects where students design and build robots and related sub-systems.

Department
Robotics Engineering
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
RBE 1001, ES 2501, and any of CS 2119 or CS 2102 or CS 2103.

RBE 2002 : Unified Robotics II: Sensing

Second of a four-course sequence introducing foundational theory and practice of robotics engineering and the application of concepts from the fields of computer science, electrical engineering and mechanical engineering to the design of robots. The focus of this course is the interactions between a robot and the environment through sensors, feedback and decision processes. Principles of electronic transducers, including performance, selection, and application of sensors will be presented. Interfaces between microcontrollers and sensors are introduced, including conditioning circuits, filters, analog-to-digital conversion, digitization, and sampling. Basic feedback mechanisms for mechanical systems will be implemented via electronic circuits and software mechanisms. The necessary software concepts will be introduced for modular design and implementation of decision algorithms and finite state machines. Laboratory sessions consist of hands-on exercises and team projects where students design and build robots and related sub-systems.

Department
Robotics Engineering
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
RBE 2001, ECE 2010, and either CS 1101 or CS 1102.

RBE 3001 : Unified Robotics III: Manipulation

This is the third of a four-course sequence introducing foundational theory and practice of Robotics Engineering. The focus of this course is on analysis & control of robotic arms, robotic manipulation, and integration of complex robotic systems, i.e., the coordinated motion of multiple actuators to execute complex manipulation tasks in the physical space. Concepts of transformations along with position and velocity kinematics will be presented, and fundamental concepts of trajectory planning, robot forces and dynamics, computer vision, and control will be introduced. Theoretical methods learned in the classroom will be applied during practical laboratory sessions, which will culminate in the construction and programming of a vision-guided, multi degree of freedom robotic manipulator.

Department

Robotics Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

BE 2002, ECE 2049, CS 2102, MA 2051, MA 2071, Experience implementing algorithms using C/C++, Java, Python, MATLAB or other programming/scripting languages.

RBE 3002 : Unified Robotics IV: Navigation

Fourth of a four-course sequence introducing foundational theory and practice of robotics engineering from the fields of computer science, electrical engineering and mechanical engineering. The focus of this course is navigation, position estimation and communications. Concepts of dead reckoning, landmark updates, inertial sensors, and radio location will be explored. Control systems as applied to navigation will be presented. Communication, remote control and remote sensing for mobile robots and tele-robotic systems will be introduced. Wireless communications including wireless networks and typical local and wide area networking protocols will be discussed. Considerations will be discussed regarding operation in difficult environments such as underwater, aerospace, hazardous, etc. Laboratory sessions will be directed towards the solution of an open-ended problem over the course of the entire term.

Department

Robotics Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

RBE 3001, ES 3011, MA 2621, or MA 2631.

RBE 3100 : Social Implications of Robotics

This course introduces students to the social, moral, ethical, legal, and current or future philosophical issues within the context of robotic systems and related emerging technology. Students will be expected to contribute to classroom presentations, discussions and debates, and to complete a number of significant writing assignments. This course is recommended for juniors and seniors. Students may not receive credit for both RBE 3100 and RBE 31 OX.

Department

Robotics Engineering

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

A general knowledge of robots and robotic systems.

RBE 4322/ME 4322 : Modeling and Analysis of Mechatronic Systems

This course introduces students to the modeling and analysis of mechatronic systems. Creation of dynamic models and analysis of model response using the bond graph modeling language are emphasized. Lecture topics include energy storage and dissipation elements, transducers, transformers, formulation of equations for dynamic systems, time response of linear systems, and system control through open and closed feedback loops. Computers are used extensively for system modeling, analysis, and control. Hands-on projects will include the reverse engineering and modeling of various physical systems. Physical models may sometimes also be built and tested.

Department
Robotics Engineering
Mechanical and Materials Engineering
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
Mathematics (MA 2051, MA 2071), fluids (ES 3004), thermodynamics (ES 3001), mechanics (ES 2501, ES 2503)

RBE 4540 : Vision-based Robotic Manipulation

This course focuses on the role of visual sensing in robotic manipulation. It covers fundamental manipulation concepts such as mathematical grasp formulations, grasp taxonomies, and grasp stability metrics. Various grasp planning strategies in the literature are studied. 2D and 3D vision-based control algorithms are covered. Point cloud processing techniques that allow object detection, segmentation, and feature extraction are studied and implemented. Students will integrate all of these aspects to design the whole vision-based robotic manipulation pipeline.
Students cannot receive credit for both 450X and 4540.
Department
Robotics Engineering
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
Knowledge of robot kinematics, wrench spaces, and rigid body transformations as presented in RBE 3001. Familiarity with robotic simulation software as presented in RBE 3002.

RBE 4815 : Industrial Robotics

This course introduces students to robotics within manufacturing systems. Topics include: classification of robots, robot kinematics, motion generation and transmission, end effectors, motion accuracy, sensors, safety systems, robot control and automation. This course is a combination of lecture, laboratory and project work, and utilizes industrial robots. Through the laboratory work, students will become familiar with robotic programming (using a robotic programming language RAPID) and the robotic teaching mode. The experimental component of the laboratory exercise measures the motion and positioning capabilities of robots as a function of several robotic variables and levels, and it includes the use of experimental design techniques.
Department
Robotics Engineering
Category
Category I (offered at least 1x per Year)
Units 1/3
Recommended Background
manufacturing (ME 1800), kinematics (ME 3310), control (ES 3011), and computer programming.

Integrative & Global Studies

AR 3150/ID 3150 : Light, Vision and Understanding

By using material from the sciences and the humanities, this course examines the ways in which ideas of knowledge and of human nature have been fashioned. The specific topics include physical theories about light, biological and psychological theories of visual perception, and artistic theories and practices concerned with representation. The mixing of material from different academic disciplines is deliberate, and meant to counter the notion that human pursuits are “naturally” arranged in the neat packages found in the modern university. The course draws upon the physical and social sciences, and the humanities, to examine how those fields relate to one another, and how they produce knowledge and self-knowledge. Cultural as well as disciplinary factors are assessed in this process. Light, Vision and Understanding is conducted as a seminar. The diverse collection of reading materials includes a number of primary texts in different fields. In addition, the students keep a journal in which they record the results of numerous individual observations and experiments concerning light and visual perception. The course can fit into several Humanities and Arts topic areas as well as serve as a starting point for an IQP. There are no specific requirements for this course, although some knowledge of college-level physics, as well an acquaintance with the visual arts, is helpful. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Art History/Architecture

Integrative & Global Studies

Category

Category II (offered at least every other Year)

Units 1/3

FY 1100 & FY 1101 : The Great Problems Seminars

The Great Problems Seminars (GPS) are a two course sequence designed to engage Worcester Polytechnic Institute's first-year students with current events, societal problems, and human needs. Each seminar starts with an important problem and introduces some of the key disciplinary tools that could be used to attack the problem. The focus for most of the second course will be a research project related to the GPS theme. Students will present their project work in a poster session at the end of the second term. Each seminar is developed and presented by an interdisciplinary pair of faculty. To participate, students must enroll in the two course sequence. Academic credit for the GPS will depend on the theme and the faculty who develop the seminar.

Department

Integrative & Global Studies

Category

Category I (offered at least 1x per Year)

Units 1/3

FY 1800 : Discovering Majors and Careers

This course is open to all students who are undecided about or are thinking about changing their academic major. Students will conduct a self-assessment utilizing career assessment tools, research majors of interest and career paths, attend major panels, speak to students/faculty in majors of interest, and participate in informational interviews with alumni. Students will meet individually with Peer Advisors and/or a CDC staff member at least three times throughout the course.

Department

Integrative & Global Studies

Units 1/12

GOV 2314/ID 2314 : Cyberlaw and Policy

Rapidly developing technologies for computing, information management and communications have been quickly adopted in schools, businesses and homes. The growth of the Internet and of e-commerce, in particular, have given rise to an entirely new set of legal issues as the courts, Congress and international bodies struggle to keep pace with changing technology. This course addresses the government's role in the development of these technologies and the legal issues that result including questions regarding privacy rights, speech and defamation, and the application of patent and copyright law. Policy questions such as surveillance of e-mail, regulation of content, mandates on the use of filters, and the responsibilities and liability of internet service providers are also discussed. Additional policies studied include attempts to control Internet content and enforce international judgments (resulting from e-commerce or cyber-crime) by foreign states and/or international organizations. Students are expected to integrate knowledge of technology with law, politics, economics and international affairs. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Political Science, Government and Law
Integrative & Global Studies

Category

Category II (offered at least every other Year)

Units 1/3

ID 2000 : Mapping Your Mission

Every student that graduates from WPI has a major, but what about a mission? This course helps participants explore their personal values, strengths, and talents and the ways they can use these personal characteristics to improve the world around them. Through the course, participants will identify a personal mission and a plan to work toward achieving their mission. Participants will explore the ways their major and their mission can intersect. Students may not receive credit for ID 200X and ID 2000.

Department

Integrative & Global Studies

Category

Category I (offered at least 1x per Year)

Units 1/6

ID 2050/SS 2050 : Social Science Research for the IQP

This course is open to students accepted to off-campus IQP centers and programs. The course introduces students to research design, methods for social science research, and analysis. It also provides practice in specific research and field skills using the project topics students have selected in conjunction with sponsoring agencies. Students learn to develop social science hypotheses based upon literature reviews in their topic areas and apply concepts drawn from social psychology, anthropology, sociology, economics and other areas as appropriate. Students make presentations, write an organized project proposal, and develop a communication model for reporting their project findings.

Department

General Social Science
Integrative & Global Studies

Category

Category I (offered at least 1x per Year)

Units 1/3

ID 2100 : Disease Detectives: an Introduction to Epidemiology

In this course, we will learn about the principles of epidemiology and the role epidemiologist play in responding to disease outbreaks and promoting public health through exploration of a series of real life cases studies. We will analyze the burden of communicable diseases today and emerging disease. We will discuss the role of current health practices and priorities as well as global organization and institutional players. Students will be introduced to the basic principles and methods used in epidemiology to study the distribution and determinants of disease in human populations and in the development of prevention and intervention strategies. The course will take an interdisciplinary approach as epidemiologist relay on many different disciplines such as biology for understanding disease processes, statistics for making efficient and appropriate use of data, social science for understanding behavior, and engineering for analysis and assessment tools. Class sessions will consist of lecture, intensive small group discussion, and case analyses. This course will be offered in 2022-23, and in alternating years thereafter.

Department

Integrative & Global Studies

Category

Category II (offered at least every other Year)

Units 1/3

ID 3100 : Teaching Methods in Mathematics and Science

Within the context of contemporary secondary education in mathematics and science (biology, chemistry, physics), ID 3100 introduces and demonstrates effective teaching methods as they relate to curriculum goals and current methods of assessment. These methods take into account diverse learning styles as well as various technological resources. Topics to be covered include: a brief history of education; curriculum and course guidelines (Massachusetts Education Reform and regulations 603 CMR 7.00, state curricular frameworks, national standards); legal issues; developing a course syllabus; and the issue of breadth versus depth in course planning and delivery. The course also covers practical questions of organizing, delivering and assessing a course. This course is intended primarily for students interested in completing the Massachusetts requirements for teacher licensing. This program is aimed primarily at majors in mathematics, physics, chemistry, biology, and certain engineering fields wishing to be licensed to teach in middle or high school in one of those disciplines. A portion of the course requires students to complete field work in a local classroom to assist them in beginning to acquire the appropriate skills to conduct their own classes in mathematics, science, or engineering at the secondary school level. Note, this course is typically held off campus at Doherty High School (approximately 1 mile from campus) so please plan for travel time when signing up.

Department

Integrative & Global Studies

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Principals of educational psychology including: understanding student characteristics, the learning process, motivation to learn, student diversity; evaluating student learning (PSY 2401)

ID 3200 : Sheltered English Immersion Endorsement Course for Teachers

This course is to prepare undergraduates looking to become future Commonwealth teachers with the knowledge and skills to effectively shelter their content instruction, so that the growing population of English language learners (ELLs) can access curriculum, achieve academic success, and contribute their multilingual and multicultural resources as participants and future leaders in the 21st century global economy.

Department

Integrative & Global Studies

Category

Category I (offered at least 1x per Year)

Units 1/3

Recommended Background

Teaching Methods or equivalent.

ID 3525/SP 3525 : Spanish American Film/Media: Cultural Issues

Through Latin American and Caribbean films, and other media sources, this course studies images, topics, and cultural and historical issues related to modern Latin American and the Caribbean. Within the context and influence of the New Latin American Cinema and/or within the context of the World Wide Web, radio, newspapers, and television the course teaches students to recognize cinematographic or media strategies of persuasion, and to understand the images and symbols utilized in the development of a national/regional identity. Among the topics to be studied are: immigration, gender issues, national identity, political issues, and cultural hegemonies. Taught in advanced level Spanish. May be used toward foreign language Minor, or Major. This course will be offered in 2021-22, and in alternating years thereafter. This course satisfies the Inquiry Practicum requirement.

Department

Integrative & Global Studies

Spanish

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

SP 2521 and SP 2522, and SP 3523.

ID 3526/SP 3526 : Comparative Business Environments

The basis of this course is a comparative study and analysis of specific Latin American and Caribbean business practices and environments, and the customs informing those practices. ID 3526/SP 3526 focuses on countries such as Mexico, Argentina, Chile, Puerto Rico, and Costa Rica. The course's main objective is to study communication strategies, business protocol, and negotiation practices in the countries mentioned above. Through oral presentations and written essays, students will have the opportunity to explore other countries in Latin America and the Caribbean. Taught in advanced level Spanish. May be used toward foreign language Minor, or Major. This course will be offered in 2022-23, and in alternating years thereafter. This course satisfies the Inquiry Practicum requirement.

Department

Integrative & Global Studies

Spanish

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

SP 2521 and SP 2522.

ID 3527/SP 3527 : Technical and Business Spanish

The course focuses on the linguistic concepts, terminology, and grammar involved in business and technical Spanish. Students will be required to produce and edit business documents such as letters, job applications, formal oral and written reports, etc. The objective of this course is to help students develop the basic written and oral communication skills to function in a business environment in Latin America and the Caribbean. This course will be offered in 2021-22, and in alternating years thereafter.

Department

Integrative & Global Studies

Spanish

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

SP 2521 and SP 2522.

ID 3529/SP 3529 : Caribbeanness: Voices of the Spanish Caribbean

A survey of Caribbean literature and arts that takes a multimedia approach to examining the different voices that resonate from the Spanish Caribbean and what appears to be a constant search for identity. By studying the works of major authors, films, music and the plastic arts, we will examine the socio-cultural context and traditions of this region in constant search for self-definition. Special attention will be given to the influential role ethnicity, colonialism, gender and socio-economic development play in the interpretation of works from Puerto Rico, Cuba, the Dominican Republic, Colombia and Venezuela as well as those of the Caribbean diaspora. This course is taught in Spanish. This course will be offered in 2021-22, and in alternating years thereafter.

Department

Integrative & Global Studies

Spanish

Category

Category II (offered at least every other Year)

Units 1/3

Recommended Background

SP3521 (Advanced Spanish I) and SP 3522 (Advanced Spanish II) or equivalent.

ID 3530/SP 3530 : Spanish Film/Media: Cultural Issues

Through Spanish films, and other media sources, this course studies images, topics, and cultural and historical issues that have had an impact in the creation of a modern Spanish nation. This course focuses on current political and ideo-logical issues (after 1936), the importance of Spanish Civil War, gender identity, and class, cultural and power relationships. This course is taught in Spanish. This course will be offered in 2022-23, and in alternating years thereafter. This course satisfies the Inquiry Practicum requirement.

Department

Integrative & Global Studies

Spanish

Category

Category II (offered at least every other Year)

Units 1/3

ID 3531/SP 3531 : Contemporary Us Latino Literature & Culture

This course introduces students to the field of Latino studies, paying particular attention to the cultural productions of U.S. Latinos in film, theater, music, fiction writing and cultural criticism. At the same time that this course reflects upon a transnational framework for understanding the continuum between U.S. Latinos and Latin American/Caribbean communities, we closely examine more U.S. based arguments supporting and contesting the use of Latino as an ethnic-racial term uniting all U.S. Latino communities. We examine the ways in which U.S. Latinos have manufactured identities within dominant as well as counter cultural registers. In this course, special attention is given to the aesthetics of autobiography and to how Latino writers experiment with this genre in order to address changing constructions of immigration, language, exile, and identity. This course is taught in English. This course will be offered in 2022-23, and in alternating years thereafter. This course satisfies the Inquiry Practicum requirement.

Department

Integrative & Global Studies

Spanish

Category

Category II (offered at least every other Year)

Units 1/3

ID 4000 : Topics in Teacher Preparation: Practicum Seminar

This course provides teacher candidates with guidance, support, and best practices to successfully complete the Massachusetts state requirements for initial licensure in a STEM field of their choice. The seminar accompanies the student-teaching experience in a local school and may not be repeated. It is an essential element in the process of completing the seven (7) essential core competencies of the Department of Elementary and Secondary Education's (DESE) Candidate Assessment of Performance (CAP) portfolio.

Department

Integrative & Global Studies

Category

Category I (offered at least 1x per Year)

Units 1/6

Recommended Background

Teaching Methods ID3100 or equivalent, Sheltered English Immersion ID3200 or equivalent, PSY2401 Psychology of Education, completion of pre- practicum fieldwork experiences 1 and 2.

Air Force Aerospace Studies

AS 1001 : Heritage and Values I (General Military Course)

The AS 1000 sequence of courses are survey courses designed to introduce students to the U.S. Air Force and Air Force Reserve Officer Training Corps. Featured topics include mission and organization of the Air Force, officership and professionalism, military customs and courtesies, and Air Force officer career opportunities. Leadership Laboratory is mandatory for Air Force ROTC cadets and complements this course by providing cadets with followership experiences. Leadership Laboratory is mandatory for AFROTC cadets and complements this course by providing cadets with followership experiences.

Department

Air Force Aerospace Studies

Category

Category I (offered at least 1x per Year)

Units 1/9

AS 1002 : Heritage and Values II (General Military Course)

Continuation of AS1001. Topics include Air Force core values, leadership principles, group leadership dynamics, and an introduction to communication skills. Leadership Laboratory is mandatory for AFROTC cadets and complements this course by providing cadets with followership experiences.

Department

Air Force Aerospace Studies

Category

Category I (offered at least 1x per Year)

Units 1/9

AS 1003 : Heritage and Values III (General Military Course)

Continuation of AS1002. Topics include Air Force core values, leadership principles, group leadership dynamics, and an introduction to communication skills. Leadership Laboratory is mandatory for AFROTC cadets and complements this course by providing cadets with followership experiences.

Department

Air Force Aerospace Studies

Category

Category I (offered at least 1x per Year)

Units 1/9

AS 1004 : Heritage and Values IV (General Military Course)
Continuation of AS1003. Topics include Air Force core values, leadership principles, group leadership dynamics, and an introduction to communication skills. Leadership Laboratory is mandatory for AFROTC cadets and complements this course by providing cadets with followership experiences.
Department
Air Force Aerospace Studies
Category
Category I (offered at least 1x per Year)
Units 1/9

AS 2001 : Team and Leadership Fundamentals I (General Military Course)
The AS 2000 sequence of courses are designed to provide a fundamental understanding of both leadership and team building. The lessons and course flow are designed to prepare cadets for field training and leadership positions in the detachment. In addition, the students will continue to discuss the importance of the Air Force core values through the use of operational examples and historical Air Force leaders, and will continue to develop their communication skills. Leadership Laboratory is mandatory for AFROTC cadets and complements this course by providing cadets with followership experiences.
Department
Air Force Aerospace Studies
Category
Category I (offered at least 1x per Year)
Units 1/9

AS 2002 : Team and Leadership Fundamentals II (General Military Course)
Continuation of AS2001. Topics include full-range leadership, problem solving, motivation, and continued development of communication skills. Leadership Laboratory is mandatory for AFROTC cadets and complements this course by providing cadets with followership experiences.
Department
Air Force Aerospace Studies
Category
Category I (offered at least 1x per Year)
Units 1/9

AS 2003 : Team and Leadership Fundamentals III (General Military Course)
Continuation of AS2002. Topics include team building, Human Relations, conflict management, and continued development of communication skills. Leadership Laboratory is mandatory for AFROTC cadets and complements this course by providing cadets with followership experiences.
Department
Air Force Aerospace Studies
Category
Category I (offered at least 1x per Year)
Units 1/9

AS 2004 : Team and Leadership Fundamentals IV (General Military Course)
Continuation of AS2003. Topics include ethical decision making, stress management, leadership capstone, and continued development of communication skills. Leadership Laboratory is mandatory for AFROTC cadets and complements this course by providing cadets with followership experiences.
Department
Air Force Aerospace Studies
Category
Category I (offered at least 1x per Year)
Units 1/9

AS 3001 : Leading People and Effective Communication I (Professional Officer Course)

The AS 3000 sequence of courses is a study utilizes cadet's field training experience to take a more in-depth look at leadership. Special emphasis is placed on enhancing communication skills, and why that is important as a leader. Cadets have an opportunity to try out these leadership and management techniques in a supervised environment as juniors and seniors. A mandatory Leadership Laboratory complements this course by providing advanced leadership experience in officer-type activities, giving students the opportunity to apply the leadership and management principles of this course.

Department

Air Force Aerospace Studies

Category

Category I (offered at least 1x per Year)

Units 1/6

AS 3002 : Leading People and Effective Communication II (Professional Officer Course)

Continuation of AS3001. Topics include, Bias, Managing Diversity & Inclusion, Cross-Cultural Competence, Managing Competing Priorities, and continued development of communication and leadership skills. A mandatory Leadership Laboratory complements this course by providing advanced leadership experience in officer-type activities, giving students the opportunity to apply the leadership and management principles of this course.

Department

Air Force Aerospace Studies

Category

Category I (offered at least 1x per Year)

Units 1/6

AS 3003 : Leading People and Effective Communication III (Professional Officer Course)

Continuation of AS3002. Topics include, Leadership theory, mentoring, Professionalism is a Decision, Ethical Decision-Making: Boundaries, Self-Awareness, and continued development of communication and leadership skills. A mandatory Leadership Laboratory complements this course by providing advanced leadership experience in officer-type activities, giving students the opportunity to apply the leadership and management principles of this course.

Department

Air Force Aerospace Studies

Category

Category I (offered at least 1x per Year)

Units 1/6

AS 3004 : Leading People and Effective Communication IV (Professional Officer Course)

Continuation of AS3003. Topics include, Creating a Vision, Organizational Climate, Establishing Expectations, Theory and innovation, and continued development of communication and leadership skills. A mandatory Leadership Laboratory complements this course by providing advanced leadership experience in officer-type activities, giving students the opportunity to apply the leadership and management principles of this course.

Department

Air Force Aerospace Studies

Category

Category I (offered at least 1x per Year)

Units 1/6

AS 4001 : National Security/Commissioning Preparation I (Professional Officer Course)

The AS 4000 sequence of courses is designed for college seniors and gives them the foundation to understand their role as military officers and how they are directly tied to our National Security Strategy. It is an overview of the complex social and political issues facing the military profession and requires a measure of sophistication commensurate with the senior college level. A mandatory Leadership Laboratory complements this course by providing advanced leadership experience in officer-type activities, giving students the opportunity to apply the leadership and management principles of this course.

Department

Air Force Aerospace Studies

Category

Category I (offered at least 1x per Year)

Units 1/6

AS 4002 : National Security/Commissioning Preparation II (Professional Officer Course)

Continuation of AS4101. Topics include, Air Force Domains, The Total Force, Defense Support of Civil Authority, Law of War, How the Air Force Deploys, Global Hot Spots, and continued emphasis is given to the refinement of communication and leadership skills. A mandatory Leadership Laboratory complements this course by providing advanced leadership experience in officer-type activities, giving students the opportunity to apply the leadership and management principles of this course.

Department

Air Force Aerospace Studies

Category

Category I (offered at least 1x per Year)

Units 1/6

AS 4003 : National Security/Commissioning Preparation III (Professional Officer Course)

Continuation of AS4102. Topics include, Base Agencies, Professional/Unprofessional Relationships, Leadership Authority and Responsibility, Religious Accommodation, Suicide Prevention, Military Justice, and continued emphasis is given to the refinement of communication and leadership skills. A mandatory Leadership Laboratory complements this course by providing advanced leadership experience in officer-type activities, giving students the opportunity to apply the leadership and management principles of this course.

Department

Air Force Aerospace Studies

Category

Category I (offered at least 1x per Year)

Units 1/6

AS 4004 : National Security/Commissioning Preparation IV (Professional Officer Course)

Continuation of AS4103. Topics include, Corrective Supervision and Counseling, Blended Retirement System, Enlisted and Officer Evaluation systems, Pay, Allowances and leave, Career Progression, the Oath of Office, and continued emphasis is given to the refinement of communication and leadership skills. A mandatory Leadership Laboratory complements this course by providing advanced leadership experience in officer-type activities, giving students the opportunity to apply the leadership and management principles of this course.

Department

Air Force Aerospace Studies

Category

Category I (offered at least 1x per Year)

Units 1/6

Military Science

ML 1011 : Foundations of Officership I

Introduction to issues and competencies that are central to a commissioned officer's responsibilities. Establishes a framework for understanding officership, leadership, and Army values. Additionally, the semester addresses "life skills" including fitness and time management. Participation in weekly training leadership laboratories; off campus training sessions (field training exercises) and other special events is required.

Department

Military Science

Category

Category I (offered at least 1x per Year)

Units 0/1

ML 1012 : Foundations of Officership II

This course continues the studies begun in ML 1011. Students make oral presentations on the elements of leadership, enhancing effective communication. Students begin to develop leadership potential by instilling self-confidence and fostering teamwork through basic survival techniques (e.g., water survival). Participation in weekly training leadership laboratories; off campus training sessions (field training exercises) and other special events is required.

Department

Military Science

Category

Category I (offered at least 1x per Year)

Units 1/9

ML 1021 : Basic Leadership I

ML 1021 expands upon the fundamentals introduced in the previous term by focusing on communications, leadership, and problem solving. "Life skills" lessons in this semester include: problem solving, goal setting, interpersonal communication skills, and assertiveness skills. Participation in weekly training leadership laboratories; off campus training sessions (field training exercises) and other special events is required.

Department

Military Science

Category

Category I (offered at least 1x per Year)

Units 0/1

ML 1022 : Basic Leadership II

ML 1022 continues by providing cadets with interesting lessons yielding immediately useful skills. The course also gives accurate information about life in the Army, including the organization of the Army, employment benefits, and work experiences of junior officers. Participation in weekly training leadership laboratories; off campus training sessions (field training exercises) and other special events is required.

Department

Military Science

Category

Category I (offered at least 1x per Year)

Units 1/9

ML 2011 : Individual Leadership Studies I

Introduces students to team building techniques. Students build upon the basic leader principals and leadership development methodologies to refine their understanding of leadership. How to build teams, how to influence, how to communicate, how and when to make decision, and creative problem-solving. Participation in weekly training leadership laboratories; off campus training sessions (field training exercises) and other special events is required.

Department

Military Science

Category

Category I (offered at least 1x per Year)

Units 1/12

Recommended Background

ML 1022

ML 2012 : Individual Leadership Studies II

The curriculum focuses on building character. Where years one, three and four focus on mastering definitions, concepts, ideas and principles, year two focuses on direct, physical experiences. Year two centers on giving cadets the opportunity to apply, practice and experience leadership principles. Cadets are asked to reflect upon their actions and those of others. Participation in weekly training leadership laboratories; off campus training sessions (field training exercises) and other special events is required.

Department
Military Science
Category
Category I (offered at least 1x per Year)
Units 1/12
Recommended Background
ML 2011

ML 2021 : Leadership and Teamwork I

Students continue the study of leader principals and are introduced to formal policies such as equal opportunity, ethics, and values. Military communication skills are trained along with the principles of camouflage. Complex cases of risk management are studied. Students will submit a written information paper. Participation in weekly training leadership laboratories; off campus training sessions (field training exercises) and other special events is required.

Department
Military Science
Category
Category I (offered at least 1x per Year)
Units 1/12
Recommended Background
ML 2012

ML 2022 : Leadership and Teamwork II

This course covers small unit movement and military tactics. It combines previous study in weapons, movement and communications to teach the combination of firepower and maneuver to the student. This course also teaches the student the elements of how the military trains its personnel. A written decision paper and practical exercise in conducting training is included in this course. Participation in weekly training leadership laboratories; off campus training sessions (field training exercises) and other special events is required.

Department
Military Science
Category
Category I (offered at least 1x per Year)
Units 1/12
Recommended Background
ML 2021

ML 3011 : Leadership and Problem Solving I

This course focuses on development of individual leadership abilities. This course reviews leadership styles, management strategies and training techniques for leaders of small units. Promoting and developing communication skills and teamwork are addressed. Examines leadership of small units conducting conventional combat operations and tactical employment of weapon systems. Development of oral communication skills through military briefings and issuance of operations orders. Special attention is placed on evaluations through practical exercises. Participation in weekly training leadership laboratories; off campus training sessions (field training exercises) and other special events is required.

Department
Military Science
Category
Category I (offered at least 1x per Year)
Units 1/6
Recommended Background
Students must have completed the basic course or ROTC Leadership Training course and have signed a personal contract with the US Army. Department Head approval is required.

ML 3012 : Leadership and Problem Solving II

Student learns how to conduct crisis planning and management. Discussion of roles and functions of combat arms, combat support, and combat service support branches. Case studies of small-unit operations are studied. Introduction to Army special operations, military operations other than war, and trends in the military. Students write self-evaluations throughout this course. Students are graded on their performance during leadership practical exercises. Attendance at monthly labs and formal social functions is required. Students write self-evaluations through this course. Students are graded on their performance during leadership practical exercises. Participation in weekly training leadership laboratories; off campus training sessions (field training exercises) and other special events is required.

Department
Military Science
Category
Category I (offered at least 1x per Year)
Units 1/6
Recommended Background
ML 3011

ML 3021 : Leadership and Ethics I

ML 3021 is designed to continue the development as leaders by presenting instruction in the three foundational areas of leadership, interpersonal communication, and values and ethics. The leadership module contains an examination of Army leadership doctrine followed by expansion on key leadership concepts and provide feedback for cadet leadership self-development efforts. Participation in weekly training leadership laboratories; off campus training sessions (field training exercises) and other special events is required.

Department
Military Science
Category
Category I (offered at least 1x per Year)
Units 1/6

ML 3022 : Leadership and Ethics II

The main thrust of the communication module is the opportunity for cadets to present an information briefing and receive feedback from both instructor and fellow students. The last module of the term contains lessons that focus on values, ethics, ethical decision-making, consideration of others, and spiritual needs. Participation in weekly training leadership laboratories; off campus training sessions (field training exercises) and other special events is required.

Department
Military Science
Category
Category I (offered at least 1x per Year)
Units 1/6
Recommended Background
ML 3021

ML 4011 : Leadership and Management I

ML 4011 begins with a series of lessons designed to enable the cadets to make informed career decisions as they prepare their accessions documents. Lessons concentrate on Army operations and training management, communications and leadership skills and support the beginning of the final transition from cadet to lieutenant. The course focuses cadets, early in the year, on attaining knowledge and proficiency in several critical areas they will need to operate effectively as Army officers. These areas include: the Army's training management system, coordinating activities with staffs, and counseling skills. While the proficiency attained in each of these areas will initially be at the apprentice level, cadets will continue to sharpen these skills as they perform their roles as cadet officers in the ROTC battalion and as new lieutenants after commissioning. At the end of this semester cadets should possess the fundamental skills, attributes, and abilities to operate as competent leaders in the cadet battalion and confidently shoulder the responsibilities entrusted to them. Participation in weekly training leadership laboratories; off campus training sessions (field training exercises) and other special events is required.

Department

Military Science

Category

Category I (offered at least 1x per Year)

Units 1/6

ML 4022 : Leadership and Management II

This Course focuses on completing the transition from cadet to lieutenant. As an expansion of the Ethics instruction in ML 3021, the course starts with an examination of unit ethical climate and the commander's role as the moral anchor of the unit. This is followed by a module addressing military law and leadership. The next module reinforces previous instruction on the organization of the Army and introduces how the Army organizes for operations from the tactical to strategic level. This is followed by instruction on administrative and logistical management that focuses on the fundamentals of soldier and unit level support. Next is a short module that focuses on preparing cadets for their forthcoming commissioning and military service. At the core of this semester is the Advanced Course's Capstone Exercise. This twelve-lesson exercise directly reinforces all modules from this term, and also incorporates and reinforces many learning objectives from modules throughout the entire curriculum. The Capstone Exercise requires cadets, both individually and collectively, to apply their knowledge to solve problems and confront situations commonly faced by junior officers. Upon completion of this course the cadets will be prepared to shoulder the responsibility of being a commissioned officer in the United States Army. Participation in weekly training leadership laboratories; off campus training sessions (field training exercises), Military Staff Ride and other special events is required.

Department

Military Science

Category

Category I (offered at least 1x per Year)

Units 1/6

ML 4023 : Officership

This course is a continuation of ML 4022.

Department

Military Science

Category

Category I (offered at least 1x per Year)

Units 1/6

ML 4024 : Transition to Lieutenant

Cadets organize and lead all the junior cadets. This course covers the military legal system, personnel actions and personal finances. It certifies fundamental competencies in land navigation, tactics, counseling, and interpersonal communications. This course requires three hours of class work and three hours of physical fitness per week. Participation in weekly training leadership laboratories; off campus training sessions (field training exercises) and other special events is required.

Department
Military Science
Category
Category I (offered at least 1x per Year)
Units 1/6
Recommended Background
ML 4023

Physical Education, Recreation and Athletics

WPE 1002 : Intro to Volleyball & Squash

Introduction to the sports through skill development and play.
Department
Physical Education, Recreation and Athletics
Category
Category I (offered at least 1x per Year)
Units 1/12

WPE 1003 : Introduction to Badminton

Introduction to the sport through skill development and play.
Department
Physical Education, Recreation and Athletics
Category
Category I (offered at least 1x per Year)
Units 1/12

WPE 1007 : Basic Water Safety

For the intermediate to advanced swimmer only. Students will learn about water recreational activities and how to remain safe while participating in them. Opportunity to learn the necessary means for safety in/near water and basic rescue techniques.
Department
Physical Education, Recreation and Athletics
Category
Category I (offered at least 1x per Year)
Units 1/12

WPE 1008 : Rowing for Fitness

This course will teach basic rowing training techniques and principles with the goal for students to develop and implement an individualized conditioning program for themselves. All classes will be conducted on-campus through the use of rowing machines located in the Sports and Recreation Center.
Department
Physical Education, Recreation and Athletics
Category
Category I (offered at least 1x per Year)
Units 1/12

WPE 1009 : Walking for Fitness

This course will teach basic walking techniques and principles with the goal for students to develop and implement an individualized conditioning program for themselves.

Department

Physical Education, Recreation and Athletics

Category

Category I (offered at least 1x per Year)

Units 1/12

WPE 1011 : Touch Football

Introduction to basic rules and individual/team skill development with practical application through game competition.

Department

Physical Education, Recreation and Athletics

Category

Category I (offered at least 1x per Year)

Units 1/12

WPE 1012 : Basketball

Introduction to basic rules and individual/team skill development with practical application through game competition.

Department

Physical Education, Recreation and Athletics

Category

Category I (offered at least 1x per Year)

Units 1/12

WPE 1013 : Softball

Introduction to basic rules and individual/team skill development with practical application through game competition.

Department

Physical Education, Recreation and Athletics

Category

Category I (offered at least 1x per Year)

Units 1/12

WPE 1015 : Badminton & Table Tennis

Instruction will focus on basic strokes and techniques. Rules, strategy and play will be integrated as students' skills develop.

Department

Physical Education, Recreation and Athletics

Category

Category I (offered at least 1x per Year)

Units 1/12

WPE 1016 : Squash & Racquetball

Instruction will focus on basic strokes and techniques. Rules, strategy and play will be integrated as students' skills develop.

Department

Physical Education, Recreation and Athletics

Category

Category I (offered at least 1x per Year)

Units 1/12

WPE 1017 : Beginning Swimming

For the non-swimmer. Students will receive instruction in basic survival skills and the primary techniques to learn to swim safely.

Department

Physical Education, Recreation and Athletics

Category

Category I (offered at least 1x per Year)

Units 1/12

WPE 1018 : Volleyball

Introduction to basic rules and individual/team skill development with practical application through game competition.

Department

Physical Education, Recreation and Athletics

Category

Category I (offered at least 1x per Year)

Units 1/12

WPE 1019 : Soccer

Introduction to basic rules and individual/team skill development with practical application through game competition.

Department

Physical Education, Recreation and Athletics

Category

Category I (offered at least 1x per Year)

Units 1/12

WPE 1054 : Plyometrics

This course will teach the use of body weight to develop personal strength and conditioning.

Department

Physical Education, Recreation and Athletics

Category

Category I (offered at least 1x per Year)

Units 1/12

WPE 1055 : Physical Conditioning

This course will teach basic strength training principles and techniques. Students will develop and implement an individualized conditioning program.

Department

Physical Education, Recreation and Athletics

Category

Category I (offered at least 1x per Year)

Units 1/12

WPE 1059 : Weight Training for Beginners

The goal of course is to provide students with the knowledge and skills in basic weight training. This course is designed to educate students about the proper use of weight training equipment and how to create their own weight training exercise program. The basic essentials for starting a weight training routine.

Department

Physical Education, Recreation and Athletics

Category

Category I (offered at least 1x per Year)

Units 1/12

WPE 1070 : Leisure Education: Redefining Social Norms

Introductory course designed to explore various leisure education alternatives.

Department

Physical Education, Recreation and Athletics

Category

Category I (offered at least 1x per Year)

Units 1/12

WPE 1077 : Swimming for Fitness

For the intermediate to advanced swimmer. This class is geared toward swimming for fitness purposes. Workouts will be administered each class period with students developing the knowledge to create workouts for themselves.

Department

Physical Education, Recreation and Athletics

Category

Category I (offered at least 1x per Year)

Units 1/12

WPE 1078 : Aquatic Conditioning

This course will teach aquatic conditioning (aerobics, walking, strength and interval training) with the goal for students to develop and implement an individualized aquatic conditioning program for themselves. For the intermediate and advanced swimmer. All classes will be conducted on-campus through the use of the pool located in the Sports and Recreation Center.

Department

Physical Education, Recreation and Athletics

Category

Category I (offered at least 1x per Year)

Units 1/12

WPE 1080 : Aquatic Games

Students will develop an understanding and appreciation of a variety of aquatic games through skill development and game play.

Department

Physical Education, Recreation and Athletics

Category

Category I (offered at least 1x per Year)

Units 1/12

WPE 1099 : Healthy Alternative Physical Education Courses

In each term, specific PE courses are offered to provide a variety of wellness, dance and healthy alternatives to traditional PE sport-based classes. The specific courses are subject to change on a yearly basis in order to provide flexibility in the PE offerings based upon the latest trends in wellness and dance. The focus of these classes is more on individual fitness, wellness and education, with instruction provided to all students in the classes.

Department

Physical Education, Recreation and Athletics

Category

Category I (offered at least 1x per Year)

Units 1/12

WPE 1200 : Club Sport - Miscellaneous

Department

Physical Education, Recreation and Athletics

Category

Category I (offered at least 1x per Year)

Units 1/12

WPE 1201 : Club Sport - Alpine Ski Team
Department
Physical Education, Recreation and Athletics
Units 1/12

WPE 1202 : Club Sport - Badminton
Department
Physical Education, Recreation and Athletics
Units 1/12

WPE 1203 : Club Sport - Ballroom Dancing
Department
Physical Education, Recreation and Athletics
Units 1/12

WPE 1204 : Club Sport - Dance Team
Department
Physical Education, Recreation and Athletics
Units 1/12

WPE 1205 : Club Sport - Fencing Team
Department
Physical Education, Recreation and Athletics
Units 1/12

WPE 1206 : Club Sport - Men's Ice Hockey
Department
Physical Education, Recreation and Athletics
Units 1/12

WPE 1207 : Club Sport - Karate
Department
Physical Education, Recreation and Athletics
Units 1/12

WPE 1208 : Club Sport - Men’s Rugby Team
Department
Physical Education, Recreation and Athletics
Units 1/12

WPE 1209 : Club Sport - Women’s Rugby Team
Department
Physical Education, Recreation and Athletics
Units 1/12

WPE 1210 : Club Sport - Men’s Ultimate Frisbee Team
Department
Physical Education, Recreation and Athletics
Units 1/12

WPE 1211 : Club Sport - Women’s Ultimate Frisbee Team
Department
Physical Education, Recreation and Athletics
Units 1/12

WPE 1212 : Club Sport - Men’s Lacrosse Team
Department
Physical Education, Recreation and Athletics
Units 1/12

WPE 1213 : Club Sport - Women's Lacrosse Team
Department
Physical Education, Recreation and Athletics
Units 1/12

WPE 1214 : Club Sport - Men's Volleyball Team
Department
Physical Education, Recreation and Athletics
Units 1/12

WPE 1215 : Club Sport - Outing: Bouldering
Department
Physical Education, Recreation and Athletics
Units 1/12

WPE 1216 : Club Sport - Pep Band
Department
Physical Education, Recreation and Athletics
Units 1/12

WPE 1217 : Club Sport - Sailing
Department
Physical Education, Recreation and Athletics
Units 1/12

WPE 1218 : Club Sport - Social Dance
Department
Physical Education, Recreation and Athletics
Units 1/12

WPE 1219 : Club Sport - SOMA (Society of Martial Arts)
Department
Physical Education, Recreation and Athletics
Units 1/12

WPE 1220 : Club Sport - SMAS: Boffer Games
Department
Physical Education, Recreation and Athletics
Units 1/12

WPE 1221 : Club Sport - Running
Department
Physical Education, Recreation and Athletics
Units 1/12

WPE 1222 : Club Sport - Men's Soccer
Department
Physical Education, Recreation and Athletics
Category
Category I (offered at least 1x per Year)
Units 1/12

WPE 1223 : Club Sport - Women's Soccer
Department
Physical Education, Recreation and Athletics
Category
Category I (offered at least 1x per Year)
Units 1/12

WPE 1224 : Club Sport - Cheerleading

Department
Physical Education, Recreation and Athletics
Category
Category I (offered at least 1x per Year)
Units 1/12

WPE 1225 : Club Sport - Scuba Co-Ed

Department
Physical Education, Recreation and Athletics
Category
Category I (offered at least 1x per Year)
Units 1/12

WPE 1226 : Water Polo

Department
Physical Education, Recreation and Athletics
Category
Category I (offered at least 1x per Year)
Units 1/12

WPE 1227 : Club Sport - Tennis

Department
Physical Education, Recreation and Athletics
Category
Category I (offered at least 1x per Year)
Units 1/12

WPE 1228 : Club Sport - Cycling

Department
Physical Education, Recreation and Athletics
Category
Category I (offered at least 1x per Year)
Units 1/12

WPE 1229 : Club Sport - Men's Rugby

Department
Physical Education, Recreation and Athletics
Category
Category I (offered at least 1x per Year)
Units 1/12

WPE 1230 : Club Sport - Competitive Climbing Co-Ed

Department
Physical Education, Recreation and Athletics
Category
Category I (offered at least 1x per Year)
Units 1/12

WPE 1231 : Club Sport - Freestyle Wrestling

Department
Physical Education, Recreation and Athletics
Category
Category I (offered at least 1x per Year)
Units 1/12

WPE 1232 : Club Sport - Equestrian

Department
Physical Education, Recreation and Athletics
Category
Category I (offered at least 1x per Year)
Units 1/12

WPE 1233 : Club Sport - Men's Basketball

Department
Physical Education, Recreation and Athletics
Category
Category I (offered at least 1x per Year)
Units 1/12

WPE 1234 : Club Sport – Women’s Basketball

Department
Physical Education, Recreation and Athletics
Units 1/12

WPE 1235 : Club Sport – Women’s Volleyball

Department
Physical Education, Recreation and Athletics
Units 1/10

WPE 1236 : Club Sport – Women’s Ice Hockey

Department
Physical Education, Recreation and Athletics
Units 1/12

WPE 1601 : Insight Program

The Insight Program provides students with skills, knowledge, and experiences that help them thrive in their transition to WPI. In collaboration with their Insight Team, students create a personalized first year experience that incorporates relationship building with their Insight Advisor as well as programmatic participation in five key areas: Academic Growth, Personal Development, Mental Health and Well Being, Diversity, Equity, and Belonging, and Social Engagement.
Department
Physical Education, Recreation and Athletics
Category
Category I (offered at least 1x per Year)
Units 1/12

WPE 1610 : Approaches to Holistic Well-Being

Introductory course designed to acquaint students with knowledge and skills necessary to make choices that foster health and well-being.
Department
Physical Education, Recreation and Athletics
Category
Category I (offered at least 1x per Year)
Units 1/12

WPE 1611 : Koru Mindfulness Meditation

Koru Mindfulness is an evidence-based mindfulness curriculum designed for college aged adults. During this course, you will learn useful, practical tools to help manage your stress and increase self-compassion. Students will practice a variety of meditation skills, engage with the Koru Mobile App, read the companion book, and participate in class discussion.
Department
Physical Education, Recreation and Athletics
Category
Category I (offered at least 1x per Year)
Units 1/12

WPE 1612 : Introductory Yoga

This yoga class focuses on connecting the mind, body, and spirit through an awareness of breath.Participating in yoga can improve core strength, flexibility, balance, mindfulness, and relaxation and decrease stress. Those with any level of yoga experience (including first timers) are welcome.

Department
Physical Education, Recreation and Athletics
Category
Category I (offered at least 1x per Year)
Units 1/12

WPE 1699 : Special Topics in Holistic Well-Being

This course provides an opportunity for students to learn about a special topic in holistic wellbeing. The topics are subject to change on a rotating basis to provide flexibility in the offerings based upon student interest and the latest practice and science of well-being.

Department
Physical Education, Recreation and Athletics
Category
Category I (offered at least 1x per Year)
Units 1/12

WPE 2001 : Varsity Football Team

Department
Physical Education, Recreation and Athletics
Units 1/12

WPE 2002 : Varsity Men's Soccer Team

Department
Physical Education, Recreation and Athletics
Units 1/12

WPE 2003 : Varsity Women's Soccer Team

Department
Physical Education, Recreation and Athletics
Units 1/12

WPE 2004 : Varsity Field Hockey Team

Department
Physical Education, Recreation and Athletics
Units 1/12

WPE 2005 : Varsity Women's Volleyball Team

Department
Physical Education, Recreation and Athletics
Units 1/12

WPE 2006 : Varsity Men's & Women' Cross Country Team

Department
Physical Education, Recreation and Athletics
Units 1/12

WPE 2007 : Varsity Wrestling Team

Department
Physical Education, Recreation and Athletics
Units 1/12

WPE 2008 : Varsity Men's Basketball Team

Department
Physical Education, Recreation and Athletics
Units 1/12

WPE 2009 : Varsity Women's Basketball Team

Department
Physical Education, Recreation and Athletics
Units 1/12

WPE 2010 : Varsity Men's & Women's Swim Team

Department
Physical Education, Recreation and Athletics
Units 1/12

WPE 2011 : Varsity Men's & Women's Indoor Track Team

Department
Physical Education, Recreation and Athletics
Units 1/12

WPE 2012 : Varsity Baseball Team

Department
Physical Education, Recreation and Athletics
Units 1/12

WPE 2013 : Varsity Softball Team

Department
Physical Education, Recreation and Athletics
Units 1/12

WPE 2014 : Varsity Men's & Women's Outdoor Track Team

Department
Physical Education, Recreation and Athletics
Units 1/12

WPE 2015 : Varsity Men's Crew Team

Department
Physical Education, Recreation and Athletics
Units 1/12

WPE 2016 : Varsity Women's Crew Team

Department
Physical Education, Recreation and Athletics
Units 1/12