2015–2016
Registration and Academic Guide

Michigan Tech
Michigan Technological University
# 2015-16 Academic Calendar

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Event</th>
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<tbody>
<tr>
<td><strong>Fall Semester</strong></td>
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<tr>
<td>Week 1</td>
<td>August 31, Monday</td>
<td>Instruction begins</td>
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<tr>
<td>Week 2</td>
<td>September 7, Monday</td>
<td>Labor Day recess</td>
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<td></td>
<td>September 8, 4:00 PM</td>
<td>Classes resume</td>
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<td>September 11, Friday noon</td>
<td>K-Day recess</td>
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<td>Week 3</td>
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<td>Week 12</td>
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<td>Week 13</td>
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<td>Week 14</td>
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<td>December 14, Monday – December 18, Friday</td>
<td>Final exam period</td>
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<td></td>
<td>December 18, Friday</td>
<td>Fall semester ends</td>
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<td></td>
<td>December 19, Saturday</td>
<td>Mid-Year Commencement</td>
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<td>Week 1</td>
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<td>Week 2</td>
<td>January 18, Monday</td>
<td>Martin Luther King Day recess, 1 day only</td>
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<td>January 19, Tuesday</td>
<td>Classes resume</td>
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<td>Week 1</td>
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<td>May 9, Monday</td>
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<td>Week 3</td>
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<td></td>
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Co-curricular Courses

Academic Program Codes

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Undergraduate Course Descriptions (Fall 2015)
Academic Programs

The requirements for all associate and baccalaureate degree programs, as well as the requirements for certificates and minors and contact information for each of the colleges and schools for the 2014-15 academic year, are listed below.

- Associate Degrees
- Baccalaureate Degrees
- Minors
- Certificates
- Colleges and Schools Contact Information

For the most accurate and up-to-date requirements, see your advisor or department. You may also select a degree audit that coincides with the academic year in which you enrolled at Michigan Tech by using the Undergraduate Degree Audit Search.

Information is also available, by clicking on the appropriate link, on the following academic opportunities available to Michigan Tech students.

- Double Majors
- Additional Baccalaureate Degrees
- Accelerated Masters
- Study Abroad
- Cooperative Education (Co-op)
- English as a Second Language
- Michigan Tech Online
- MICUP Transfer Transition Program
- Secondary Teacher Certification

The University reserves the right to change the requirements for graduation as a means of keeping pace with educational, scientific, and technological developments. Changes may be applied to students already enrolled, but every effort will be made to give the student the benefit of the new educational program without imposing undue hardship.

Baccalaureate Degrees
Michigan Tech has a variety of four-year degree programs. This section presents the requirements for a Bachelor of Science or a Bachelor of Arts degree (BS or BA), listed alphabetically by college or school.

Some degrees also specify requirements for particular concentrations. Students interested in obtaining a minor, certificate, double major, or an additional degree should consult with their academic advisors.

Minors
The purpose of a minor is to officially recognize a student who takes a prescribed set of courses in a discipline outside their major. To receive a minor, students must be currently enrolled in a bachelor's degree program at Michigan Tech, have indicated that they are pursuing the minor by submitting a Curriculum Add/Drop form, and have completed all requirements for the minor. The award will be noted on the official transcript.

A student must add the minor to their record no later than the time when the student submits their application for graduation. A student cannot be awarded a minor that has the same title as their major or major concentration. Students who wish to pursue a certificate in the same academic discipline or subject area as a minor must receive permission from the academic department.

In addition to meeting the requirements specified by the academic unit offering the minor, a student must:

- Maintain a minimum cumulative grade point average of 2.0 for courses completed as part of the minor.
• Take at least 6 credit hours of 3000-level or higher minor-required courses that are not required as part of their major (except as free electives). If more than one minor is being pursued, the 6 credit hours of 3000-level or higher minor-required courses that are not required as part of their major (except as free electives) must be unique to each minor.

• At least 6 credits of the 3000-level or higher minor-required courses must be taken at Michigan Tech. Courses that meet the "at Michigan Tech" requirement are defined as courses listed in the course catalog and taught by a Michigan Tech instructor either on campus, at field locations, or through distance learning.

Certificates
A certificate is awarded upon completion of a body of courses providing students with knowledge of a disciplinary or interdisciplinary subfield. Certificates are noted on official transcripts and allow departments to offer curricular options not offered as a minor or a concentration within a major.
Certificate programs require:
• At least 12 and no more than 25 credits, at least one-half of which must be at the 3000 level and higher.
• Students must earn a grade of C or better in each course that is used to meet certificate requirements.
• Departments offering certificates may establish GPA requirements up to 2.5.
Programs for Everyone

Double Majors
A double major is a Michigan Technological University bachelor's degree with two majors and is granted when all requirements of both curricula are satisfied at the same time. A student who completes a double major will be awarded one diploma listing both majors, for example, "Bachelor of Science in Mechanical Engineering with an additional major in Mathematics".

- The double major is distinctly different from the second degree. Majoring in two subjects does not require additional credit hours beyond departmental requirements and only a single degree is granted. Double majors work best for degree programs with similar curricular structures. When two majors have very different requirements necessitating the completion of 32 or more "additional" credits, students should consider a second degree program that results in the awarding of two distinct baccalaureate degrees and diplomas.
- A student pursuing a double major will designate one as the primary major. Students planning to earn a double major should declare both majors and begin planning their course work as early as possible. Advisors must be identified in the departments of both majors in order to assure that the degree requirements of both are met.
- Students may only earn an additional major if that major is offered under the same degree type (Bachelor of Science or Bachelor of Arts) as the primary major. If the degree types for the majors are different then the student must pursue a second degree.
- If a single department offers two distinct majors, it is possible to complete a double major within that department by fulfilling the requirements for both majors. However, student may not earn a double concentration or option within a single major.
- In the event that both majors require a senior project, a student may petition both departments to accept one project for both majors prior to beginning the senior project.
- Students who have previously been awarded a degree cannot have the double major designation added to their transcript.

Students desiring a double major should indicate their intent by filing a Curriculum Add/Drop form (available in the department advising office) complete with signature from the academic advisor for the additional department with the Registrar's Office.

Additional Baccalaureate Degrees
A student enrolled at Michigan Tech who is currently pursuing (or already has) a Baccalaureate degree or degrees can obtain an additional Baccalaureate degree from Michigan Tech. Unlike a double major, an additional Baccalaureate degree (or degrees) will grant the student an entirely separate diploma. Students must initiate the process for obtaining an additional degree by completing a degree audit with their additional degree advisor. Students pursuing a Baccalaureate degree from Michigan Tech can earn an additional degree at the same time if they meet the following requirements:

- Satisfy the degree requirements for each Baccalaureate program.
- Earn at least 32 of the credit hours required for the additional degree through Michigan Tech without having applied those credits to any other minor or Baccalaureate degree program. The academic unit offering the additional degree can allow course substitutions provided that the 32 credit hour minimum is maintained.

An enrolled student who has already earned a Baccalaureate degree (from Michigan Tech or from a regionally accredited institution of higher education) can obtain a Baccalaureate degree or degrees from Michigan Tech if they:

- Complete an Additional Baccalaureate Degree Completion Form with their advisor.
- Satisfy the degree requirements for the additional Baccalaureate program.
- Earn at least 32 of the credit hours required for each additional degree through Michigan Tech without having applied those credits to any other minor or Baccalaureate degree program. The academic unit offering the additional degree can allow course substitutions provided that the 32 credit hour minimum is maintained.
A student who plans to pursue an additional baccalaureate degree must also submit a Curriculum Add/Drop form, complete with signature from the academic advisor in the degree-granting department, to the Registrar's Office.

**Accelerated Master's Degree**

Undergraduate students may pursue a master's degree in conjunction with their baccalaureate degree by applying a limited number of credits toward both the master’s and bachelor’s degrees using the following student guidelines:

- Only students who intend to complete both their bachelor’s and master’s degrees at Michigan Tech can enroll in an accelerated master’s program.
- Students already enrolled in a graduate program may not retroactively use this policy.
- In order to be formally accepted into an accelerated master’s program students must apply to and be accepted into the Graduate School at Michigan Tech. Applications will be reviewed by departments and programs according to their normal procedure.
- Students can apply for admission to an accelerated master’s program at any time after they attain sophomore-level class standing and up until they are awarded their bachelor’s degree.
- Only students with a cumulative GPA of 3.0 or above are eligible to enter an accelerated master’s program. Programs may set higher admission requirements. For example, programs may require a cumulative GPA of 3.5 for admission to a research-based (thesis or report option) master’s program.
- Students who are accepted to the program will not be allowed to continue if their cumulative undergraduate GPA falls below 3.0. A higher GPA may be required by the program.
- Students must consult with their academic advisor and the Graduate School regarding restrictions on the use of coursework and research credits under the accelerated master’s degree policy prior to enrollment in any courses intended to be used toward the master’s degree. A maximum of six credits may be double-counted toward the bachelor’s and master’s degrees.
- Students will be considered undergraduates for the purposes of financial aid, tuition, and class standing until their undergraduate degree has been awarded. Once students are awarded their undergraduate degree, they will be considered graduate students for the purposes of financial aid and tuition.
- Students who are accepted into an accelerated master’s degree program may also take courses under the senior rule policy. Students must consult the graduate program regarding the number of senior rule courses that may be used toward an accelerated master’s degree.
- Additional information for academic departments may be found in the accelerated master’s University Senate degree policy.

The **Graduate School** maintains a list of programs that are currently available as an accelerated program.

**Study Abroad**

What better way to create the future than to **study abroad**? The International Programs and Services Office provides students with high-quality international academic opportunities in more than thirty nations around the world. Every year, hundreds of students choose to study abroad for a summer, semester, or year at a foreign university. Students will earn credit toward their degree or minor, and spend a once-in-a-lifetime opportunity developing skills needed to become productive and successful members of the global community.

Study abroad programs at Michigan Tech are very affordable because tuition will at be at least the same as your Michigan Resident or Non-Michigan Resident tuition rate for most of the programs. Financial aid and scholarships usually apply to semester and year-long programs. The Office of International Programs and Services is an excellent resource for available scholarships and grants.
Students from every discipline choose study abroad, especially considering that many courses abroad are taught in English. While knowledge of a foreign language is not necessary for many programs, living abroad is an excellent way to improve language skills.

**Cooperative Education (Co-op)**

Michigan Tech encourages undergraduate and graduate students to participate in experiential education, which includes both co-ops and internships, because it provides the professional experience which is so highly sought by employers. The goal of the Experiential Education Program at Michigan Tech is to provide practical work experience prior to graduation. As a joint venture between the student, the University, and an employer, work assignments are related to the student's major field of study and are varied to provide a range of training and experience.

The work assignment's degree of complexity are intended to match the level of the student's training, progressing with each work assignment. Since the co-op student must complete the same academic program as a non-co-op student, the co-op student typically defers graduation by as much as a full calendar year. However, both the short and long-term benefits gained through experiential education are worth the extra time.

To qualify for the co-op program as an undergraduate or transfer student, an applicant must have second year standing (i.e., 30+ credits) and a Michigan Tech University GPA above 2.2. Also, undergraduate students must be in good academic and social standing with the University in order to be registered. Each semester of undergraduate co-op carries 1 or 2 academic credits, which may be applied toward an academic degree, depending on the degree-granting department. Graduate students are required to have been on campus for a year and maintain at least a 3.0 GPA. Additionally, they must obtain permission from their advisor and have full-time student status while applying for and participating in the co-op assignment. Graduate students may earn from 1 to 6 credits per co-op semester.

Co-op program options are designed to accommodate the needs of both the student and the employer. Co-op assignments may range from one semester to a full year or rotate between school and work sessions.

Michigan Tech has entered into a cooperative education relationship with more than 2,000 companies and organizations in the United States and abroad. Although a majority of students choose to co-op in the Midwest, students have been placed across the nation and internationally. For more information, visit Career Services Co-ops and Internships.

**English as a Second Language Program**

The Intensive English as a Second Language (IESL) Program provides instruction in English for academic purposes and North American culture for international students interested in pursuing a degree at Michigan Tech.

IESL classes follow Michigan Tech’s academic calendar and are offered during fall, spring, and summer semesters. IESL courses include all language skills: reading/vocabulary, writing/grammar, and listening/speaking/pronunciation at the intermediate, advanced and transitional levels.

For more information, contact the IESL Program at iesl@mtu.edu or call 906-487-2540.

**Michigan Tech Online Learning**

Michigan Tech offers select courses online to degree- and non-degree seeking students. Courses can be used toward certificate, BS, MS, and PhD programs. Both corporate sponsors and individuals are eligible. Online courses offer more flexibility than a face-to-face class but are not designed to be completed at your own pace.

**MICUP/MI-LSAMP Transfer Transition Program**

The Michigan College University Partnership (MICUP) Transfer Transition Program, partnered with the Michigan Louis Stokes Alliances for Minority Participation (MI-LSAMP), focuses on the recruitment and support of underrepresented and economically disadvantaged community college students to academic programs at Michigan Tech. Our current community college partners are Delta College, Grand Rapids Community College, and the Wayne County Community College District.
The program includes a seven-week summer university and residential experience, undergraduate research with a faculty member, and the opportunity to enroll in a 3-credit Michigan Tech course. If selected to attend, these and other opportunities are provided at no cost to students. A competitive stipend is granted to each participant.

For more information, contact the Center for Diversity and Inclusion at 906-487-2920.

**Secondary Teacher Certification**
Specific major programs grant both secondary school teacher certification and a bachelor's degree in the following certification areas. You must apply to the Department of Cognitive and Learning Sciences for admission to these programs.

- Biology (BS in Biological Sciences or Medical Laboratory Science, BS in Wildlife Ecology, Applied Ecology, or Forestry)
- Chemistry (BS in Chemistry)
- Computer Science (BS in Computer Science)
- Earth Science (BS in Geology)
- Economics (BS in Economics)
- English (BA in English)
- Integrated Science (BS in Engineering or Sciences)
- Mathematics (BS in Mathematics)
- Physics (BS or BA in Physics)
- Social Studies (BS in Social Sciences)

**Officers’ Training (ROTC)**
The Reserve Officers’ Training Corps (Army or Air Force) is open to all US citizens enrolled at Michigan Tech. Students may enroll in Army (AR) or Air Force (AF) courses during the first two years with no obligation to the service. Those students holding ROTC scholarships become obligated to their respective service at the beginning of their sophomore year. Students completing the Army program may receive a commission as an officer in the Army. Students completing the Air Force program will receive a commission as an officer in the Air Force.

**Preprofessional Programs**
Many different undergraduate majors and courses of study can lead to successful admission to professional schools after completion of a bachelor's degree. Admission requirements of professional institutions vary; therefore, it is the student's responsibility to determine if a suggested program at Michigan Tech meets the admission requirements of a particular institution's professional programs. Students should consult with their academic advisor for courses of study.

Three departments on campus have specific programs for students pursuing professional careers in medicine and the related health sciences or in law. The prephysical therapy advisor, located in the Department of Kinesiology and Integrative Physiology, assists students preparing for admission to physical therapy school. The premedical advisor, located in the Department of Biological Sciences, helps students preparing for admission to schools of medicine, dentistry, optometry, pharmacy, podiatry, veterinary medicine, and other health professions. The prelaw advisor, located in the Department of Social Sciences, works specifically with students interested in pursuing careers in law.
Academic Policies and Procedures

Academic Advancement

Credits—Academic advancement is measured in terms of semester credit hours or, simply, credits. The number of credits required for the bachelor's degree, which varies among departments, averages about 128 semester credits. Students may receive an undergraduate degree in approximately eight semesters, depending on their semester course load and degree requirements.

Class Standing—Determined by number of credit hours.

- First-year students 0–29.99 credits
- Sophomore 30–59.99 credits
- Junior 60–89.99 credits
- Senior 90+ credits

Full-Time Load—Defined as 12–18 credits per semester. When deciding the pace of academic advancement, students should consider their cumulative course workload as well as number of credit hours. Two hours of outside preparation are expected for each hour of lecture and recitation. A student in a 4-credit class would be expected to spend eight hours weekly in outside preparation.

Maximum Credit Load—The maximum load a student may carry will be subject to the following limits:

1. The student load is prescribed by individual departments; the maximum is 18 credits per semester.
2. A student with a 3.00 cumulative grade point average may be permitted to take additional credits with the approval of the student's academic advisor.
3. A student on academic probation shall not be permitted to register for more than 16 credits per semester unless approval is granted by the Dean of Students Office.

Academic Work

Attendance—Attending class is essential for academic success. The University expects students to attend all scheduled class times unless an absence is excused under this policy. For more information, please review Michigan Tech’s Attendance Policy.

Absences—Students are responsible for notifying their instructors prior to missing a class and arranging a mutually-acceptable make-up procedure. In emergency situations, where students are unable to notify their instructors, students should promptly contact the Dean of Students Office for assistance. Students with an excused absence, as defined in the Attendance Policy, will be allowed to make up missing assignments or equivalent work.

Final Exams—Final exams are those tests scheduled for a special period following the last week of instruction which is referred to as "final exam week". This period begins and ends with the first and last officially scheduled final examinations. Each department shall designate all courses or sections of courses in which final examinations are to be given. The University shall not schedule, nor shall the students participate in, any official function during the scheduled final exam period except events whose date is beyond the control of the University. Absences from final exams need not be excused when caused by a student scheduling courses with conflicting final examination times. For more information, please review the Final Exam Policy.

Evening Exams—Regular exams are exams and quizzes that are not defined as final examinations. Evening exams are regular exams held outside of scheduled class times, usually after 6 p.m. Evening exams should be scheduled for 6-7 p.m., Monday-Thursday. The University shall not schedule classes for this time period. Please see the Evening Exam Policy for more information.

Winter Carnival Week Exams—Hour examinations shall not be given during that portion of Winter Carnival week beginning at 6 p.m. Tuesday and ending at termination of classes on Thursday. An hour examination is taken to be any
major examination comprising a significant portion of a student's overall grade and which would require major preparation.

**Academic Integrity**—Students who cheat, plagiarize, or fabricate data, as well as students who help others to cheat, plagiarize, or fabricate, can receive disciplinary sanctions of warning, probation, suspension or expulsion from the University, depending on the severity of the offense. For more information, see the Academic Integrity Policy.

**Individual Efforts**—The University expects students to work independently on individual assignments and examinations and to follow acceptable academic practices. While group efforts and study groups are often appropriate, students must submit their own work. Students should direct any questions concerning use of outside resources or collaboration on assignments to their course instructor.

**Weather Closure Policy**—The president, provost and vice president for academic affairs, or their designated representative may decide to close the University for a specified period of time (examples might include but are not limited to prolonged power outage, prolonged loss of heating capability, or closure of main highway due to inclement weather). Notification will be through Safety First Alert, the University website, and local media. Faculty and students will be excused from reporting to class.

**Advising**

Upon enrollment, students are assigned academic advisors by their major departments. Students are urged to consult their advisors regularly for support in developing and achieving their academic and career goals. Students who have not declared a major should consult the "undeclared advisors" in General Sciences and Arts or Engineering Fundamentals. See Student Advising.

**Orientation**

Orientation is a program designed to introduce new students to academic life, campus, and their classmates. For students entering in fall semester, attendance at the week-long Orientation program is required for all new first-year students. Transfer students with more than 30 credits are required to attend a one day orientation program. During orientation programs, students will learn about campus resources, university policies, and extracurricular activities. Students will meet with their academic department and advisor to discuss departmental expectations and curriculum. Students will also have the opportunity to meet other students, become familiar with their new community, and to attend programs regarding the academic and social transitions to college life, specifically Michigan Tech. For students entering in spring and summer semesters, a condensed orientation is required.

**ExSEL (Excelling the Student Experience of Learning)**

ExSEL is designed to promote student success and encourage leadership development. The program offers academic support through services such as one-on-one meetings with staff, peer mentoring, grade monitoring, campus resource referrals, campus and community involvement opportunities, special events, and workshops. Additionally, participants enroll in the one-credit, graded UN1000, Frameworks for Success, course. This course provides an opportunity to learn about time management, study skills, working effectively in groups, civic leadership, utilizing campus resources, and other aspects of college life that contribute to student achievement. ExSEL also provides opportunities for students to participate in leadership positions as mentors, teaching assistants, and student employees.

**Learning Centers**

To support student success, Michigan Tech has learning centers offering peer and professional academic coaching through weekly appointments, team learning groups, and walk-in tutoring for the following areas: biological sciences, business and economics, chemistry, civil and environmental engineering, computer science, electrical and computer
engineering, engineering fundamentals, forestry, mathematics, mechanical engineering, multiliteracies (writing), and physics.

**Academic Standing**

It is the responsibility of students to stay informed about their academic standing at all times. The academic progress of degree-seeking and of nondegree-seeking undergraduate students is monitored.

**Good Academic Standing**

The following are conditions of Good Academic Standing:

1. The University cumulative GPA is 2.00 or greater.
2. The GPA for the most recent semester is 2.00 or greater.
3. The cumulative GPA in the major department is 2.00 or greater, based on at least 16 credits.

**Dean's List**—Degree-seeking undergraduate students who complete 12 or more grade point credits with a GPA of 3.50 or higher in any semester are placed on the Dean's List. Dean’s List status is recorded on the students’ transcripts and is also released to hometown newspapers and posted by the Dean of Students Office online.

**University Honors List**—University Honors are reserved for degree-seeking students who rank in the top 2 percent of their class and maintain at least a 3.5 cumulative GPA while carrying 12 credits or more for fall and spring semesters.

**Graduation with Honors**—Michigan Tech recognizes outstanding honors achievements of baccalaureate and associate degree candidates at commencement, on diplomas, and on transcripts with the Latin scholastic distinctions of summa cum laude, magna cum laude, and cum laude. Individual honor designation is determined by their cumulative grade point average.

All grades, which are on a point basis, are used to determine the cumulative GPA. Grades such as I, M, N, P, Q, S, V, etc. are not included in GPA calculations.

Commencement program honor designations are based on the cumulative GPA at the close of the preceding semester. Diploma and transcript honor designations are based on the cumulative GPA achieved after successful completion of all degree requirements.

Academic Honors are granted on the following basis:

- 3.9–4.0 *summa cum laude* (highest honors)
- 3.7–3.89 *magna cum laude* (high honors)
- 3.5–3.69 *cum laude* (honors)

**Academic Difficulty**

Students having academic difficulty may be asked to withdraw from specific courses, be placed on academic probation, be academically suspended, or dismissed from the University.

**Required Course Withdrawal**—The Dean of Students Office may, on the recommendation of the department chair, require students to withdraw from any course or courses in which their preparation, progress, effort, or conduct is deemed unsatisfactory.

**Academic Probation**—Students who are not making satisfactory progress toward a degree are placed on academic probation. Academic probation is a strong warning to students that their scholastic performance is less than that expected by the University. Notices of academic probation are sent to students at the same time grades are available at the end of the semester. Failure to improve after receiving a probation notice can result in academic suspension or dismissal from the University (see below).
A student seeking an undergraduate degree is placed on academic probation under any of the following three conditions:

1. The University cumulative GPA is below 2.00.
2. The GPA for the most recent semester is below 2.00.
3. The cumulative departmental GPA is below 2.00, based on at least 16 credits.

A student on academic probation is not permitted to register for more than 16 credits per semester unless approval is granted by the Dean of Students Office.

A student is removed from probation when the following conditions have been met:

1. The University cumulative GPA is 2.00 or greater.
2. The GPA for the most recently completed semester is 2.00 or greater.
3. The cumulative departmental GPA is 2.00 or greater, based on at least 16 credits.

**Academic Suspension and Dismissal**—A student is eligible for academic suspension if the student earns a term GPA of 0.0 while attempting 12 or more credits, if the cumulative GPA is below 2.0 after a semester of academic probation, or if the student is not restored to good academic standing after two semesters of probation regardless of the cumulative GPA. A student who receives a notice of academic suspension will not be permitted to enroll at the University for a specified period of time.

Upon receiving a first notice of academic suspension, a student must sit out for at least one semester, plus a summer. That is, a student suspended at the end of a fall semester may not re-enroll until the following fall, and a student suspended at the end of a spring semester may not reenroll until the following spring. Upon receiving a second notice of academic suspension, a student must sit out two semesters, plus a summer. Upon reinstatement after a second suspension, failure to achieve good academic standing or show substantial academic progress within one semester will result in academic dismissal. There is no opportunity for reinstatement after academic dismissal.

**Appeals of Academic Suspension/Dismissal**—An appeal of academic suspension or dismissal will be considered if documentation can be provided to show unusual or extenuating circumstances surrounding a student’s academic performance. The student must also be confident in his or her ability to show significant academic progress. A student wishing to make an appeal must do so in writing to the dean of students by accessing the appeal form through the Academic Standing link in [MyMichiganTech](#).

**Reinstatement**—A student suspended for unsatisfactory academic progress may apply for a reinstatement through a written request to the dean of students after a period of nonenrollment. This request can be made by accessing the reinstatement form through the Academic Standing link in [MyMichiganTech](#). A reinstatement request must be made six weeks in advance of the term you wish to attend and should be supported by materials that demonstrate your readiness to be a successful student.

A student who is reinstated after academic suspension is placed on academic probation, and will be enrolled under the academic catalog and degree-program curriculum in effect at the time of reinstatement.

Upon reinstatement, failure to achieve good academic standing or show substantial academic progress by the end of one semester will result in a second suspension. Upon reinstatement after a second suspension, failure to achieve good academic standing or show substantial academic progress within one semester will result in academic dismissal. There is no opportunity for reinstatement after academic dismissal.

**Academic Renewal**

Students who withdraw from the university following one or more terms of poor academic performance occasionally return to the university to continue their education. Their prior low GPA may not be indicative of their potential and may pose a significant challenge to achieving university standards of acceptable academic performance. Prior low grades may also serve as a deterrent to re-enrollment to resume study. Academic Renewal is designed to give returning students a second chance by providing an opportunity to remove a certain portion of prior course work from grade point computation.
Academic Renewal Qualifications

- A student enrolling at Michigan Tech after an absence of five (5) years or more may elect Academic Renewal. This renewal will affect only those courses taken prior to the five (5) year absence and may be elected only once. Academic Standing will be initialized to ‘Good Standing’ for students electing Academic Renewal.

- Academic Renewal is open only to undergraduate students admitted into a degree program. Academic Renewal is forfeited if a degree program is not completed.

- Academic Renewal must be invoked prior to graduation and is not available to students who have previously completed requirements for a Michigan Tech Bachelor’s or Associate’s degree.

- If more than one term is elected for Academic Renewal, the terms must be consecutive and have been completed within a maximum of two (2) calendar years for Bachelor’s degrees or one (1) calendar year for Associate’s degrees.

- A student receiving a Bachelor’s or Associate’s degree from Michigan Tech must meet the University residency for graduation requirement in the interval between the most recent course work elected for renewal and the completion of courses at Michigan Tech.

- To qualify for Academic Renewal, a student must have an overall GPA below 2.0 for the renewal period.

- Renewal will apply to all courses taken during the period for which it is elected regardless of the grade earned. No course credit is granted for any courses in Academic Renewal terms. Academic Renewal courses are not subject to the existing Repeat Policy rules.

- All courses and grades in Academic Renewal terms will remain on the student’s transcript with a notation that “Academic Renewal has been granted”. All grades will be annotated with an ‘R’ indicating Renewal, e.g. RD or RF. Grades thus annotated will be excluded from University grade point average computation.

- Academic renewal is a policy of Michigan Technological University. As such, students should be aware it may not be recognized by outside institutions or agencies (e.g. Michigan Department of Education, other universities and colleges).

- Once elected, Academic Renewal is irrevocable. Students must consult with their academic advisor prior to election of Academic Renewal. Signed application forms will be processed and retained by the Registrar’s Office.

Students may obtain a petition form through the Registrar's Office and must consult with their academic advisor prior to election of academic renewal. Students who left the university voluntarily may re-enroll by contacting the Registrar’s Office. Those who did not leave voluntarily must seek re-enrollment through the Dean of Students Office. Requests are evaluated on a case-by-case basis.

**Conduct**

Michigan Technological University “prepares students to create the future”. In doing so, the University inspires the values of community, scholarship, possibilities, accountability and tenacity. These values should serve to guide decisions and foster learning. Standards of conduct are set forth in the Student Code of Community Conduct to assist the University community in furthering its mission and values.

Attendance at the University is both voluntary and a privilege. Upon enrollment, students have the responsibility to uphold the rules and values of the University, and the right to a fair and equitable conduct process. Students, student groups, and/or student organizations are responsible for knowing the information, policies, and procedures outline in the Code.

The student conduct process at the University is not intended to punish students; rather, it exists to protect the interests of the community and to guide and educate those whose behavior is not consistent with our policies. The purpose of the student conduct process is to determine responsibility, not guilt or innocence. This is not a criminal or civil trial; it is educational in nature, although sanctions can be imposed if a student is responsible for a conduct violation. Sanctions are
intended to challenge student’s moral and ethical decision-making and to help them bring their behavior into accord with our community expectations.

While the University has a primary duty to supervise behavior on its premises, there are many circumstances where the off-campus behavior of students affects University interest and warrants action. The University expects students, groups/organizations to conduct themselves in accordance with the law. Off-campus behavior by a student, group and/or organization that may be a violation of local, state or federal law, or yields a complaint from others alleging law violations or misconduct will be reviewed by the Office of Academic and Community Conduct.

The University will take all actions that it deems necessary and appropriate to protect the integrity and best interests of the University and the University community. Such action may include modifying this Code without notice as well as instituting procedures for prohibited conduct (on or off campus), including study-abroad programs. While some deviation from practices described in the Code may at times be necessary, every effort will be made to ensure that the intent of fairness of the Code is maintained. The Code is a dynamic document, and as such is periodically reviewed, and can be modified. It is the responsibility of every member of the University community to periodically review the Code. Final authority in conduct matters is vested in University administration and the Board of Trustees.

Sex Discrimination/Sexual Harassment—Michigan Tech must provide a fair and responsible environment for all of its students. Title IX of the Education Amendments of 1972 is a law prohibiting discrimination based on sex in educational programs that receive Federal funds. It states: "No person in the United States shall, on the basis of sex, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any education program or activity receiving Federal financial assistance."

The Title IX Coordinator is responsible for Title IX compliance. The Title IX Coordinator and Deputy Coordinators provide assistance and information about discrimination on the basis of sex in educational and athletic/recreation programs including gender based discrimination, pregnant and parenting discrimination, sexual harassment, and sexual violence. The coordinators can assist you with filing and addressing a complaint, ensure that you can continue your education free of ongoing discrimination, act to remedy the harm, and provide you resources.

The Title IX Coordinator for the university can be contacted at titleix@mtu.edu, 906-487-3310, Room 306 in the Administration Building.

For complaints regarding gender equity in Michigan Tech athletics and recreation, contact the Director of Athletics and Recreation, who is responsible for monitoring and oversight of this area for coaches, staff, student-athletes, and students at 906-487-3070 or Room 239A in the Student Development Complex.

For information on student conduct and the Sexual and/or Relationship Misconduct policies, visit the website.

For information on Title IX visit the website.

Substance Abuse—The University encourages and promotes an environment where healthy lifestyle choices can be made every day by students, faculty, and staff. Students may obtain substance abuse consultation and counseling through Counseling Services. Michigan Tech is committed to following the guidelines of the Drug-Free Schools and Community Act of 1988.

Michigan Tech recognizes that substance abuse has a detrimental effect on the University's goals and objectives. It affects the intellectual, social, physical, and moral growth and development of the individual and the campus community. To reduce the effects that substance abuse promotes, Michigan Tech expects each person to accept the responsibility for his or her own choices and behavior. The University will intervene in any substance abuse-related behaviors that have a negative effect on any segment of the University community or violate any city, state, or federal law. For specific drug and alcohol policies, refer to the "Alcohol and Other Drug Policy" available in the Dean of Students Office or here.
Disabilities (ADA)
Michigan Tech is dedicated to assuring and enhancing opportunities for students with disabilities. The University does not discriminate in the recruitment, admission, or treatment of students. A student with a documented disability may request accommodations that will enable the student to participate in and benefit from educational programs and activities. Documentation must be provided by qualified medical professionals.

To request accommodations, a student must present documentation to the Student Disability Services (SDS) Office. Upon the student's request, instructors will be notified of the student's need for accommodation (such as extended time to complete examinations, permitting examinations to be individually proctored, or permitting the use of digital recorders in the classroom). Other out-of-class accommodations may be requested and approved, depending on documentation. Students are required to give instructors a minimum of 5 business days notice prior to using accommodations in the classroom. Please see the Student Disability Services web page.

Grade Reports
Mid-Semester Grades—Grades of “satisfactory” (C or better) or "unsatisfactory" are given to all first-year students at mid-semester. Final letter grades are provided at the end of each semester.

Semester—Students may access their final semester grades through Banweb (Student Information System). Grades are mailed to the student only upon request. Contact the Registrar's Office for more information.

Disputed Grades—A student having an error in a final course grade should contact the instructor as soon as possible but no later than one month after the beginning of the next semester. Graded student work (exams, papers, homework, etc.) that has not been returned to the student should be retained by the instructor of record for at least 30 days after the beginning of the next semester or until existing disputes have been resolved.

Transcript Requests
Official Transcripts are provided free of charge upon request from the Michigan Tech Student Service Center. Transcript requests are processed as they are received, and turnaround time is kept to a minimum. All financial obligations to the University must be satisfied before a transcript will be released.

Students who attended prior to 2003 may request a transcript in person, by mail, or by fax

Methods of Requesting a Transcript:

Online — If you are a current student or a former student who attended Michigan Tech since 2003, you can log into Banweb (Student Information System). Enter your campus username and ISO password to login. Once you have gained access, click on student services, student records, then select an official or unofficial transcript. If you have questions, email registrar@mtu.edu or contact the Student Service Center at 906-487-2319.

In Person—Come to the Student Service Center with your Michigan Tech ID or other photo identification. Office hours are 8:00 AM to 5:00 PM during fall and spring semesters and 7:30 AM to 4:00 PM during summer semester. You will receive your transcript immediately upon presentation of appropriate identification.

By Email, Fax or Mail—To request a transcript by email, fax or mail, complete and submit the transcript request form.

Grading Policies
Grade Point Average (GPA)—The grade and credit earned for any course taken by a student at Michigan Tech will become part of the student's permanent record and will be used in the computation of the University grade point average (GPA).

The GPA is computed by dividing the grade points by the grade point hours and truncating the result. Grade point hours include those course credits with grades of A, AB, B, BC, C, CD, D, F, and X. Any performance below a GPA of 2.00 is considered a grade point deficiency.
Minimum GPA—It is required that a student earn a minimum cumulative 2.00 GPA and a minimum 2.00 GPA in the student’s major department for an undergraduate degree. Incomplete (I) grades remaining at graduation are considered failing (F) grades in computing the final GPA.

Grading System—The grades awarded by the University are

- A (excellent)—4.00 grade points/credit
- AB (very good)—3.50 grade points/credit
- B (good)—3.00 grade points/credit
- BC (above average)—2.50 grade points/credit
- C (average)—2.00 grade points/credit
- CD (below average)—1.50 grade points/credit
- D (inferior)—1.00 grade points/credit
- F (failure)—0.00 grade points/credit
- F* (failure due to academic dishonesty)—0.00 grade points/credit

- I (incomplete) not computed in GPA calculation appropriate when
  - the student has a legitimate extenuating circumstance prohibiting the completion of the course;
  - the student has the ability to complete the course requirements without re-enrolling in the course;
  - the student currently has a passing grade in the course.

- Extenuating circumstances may include (but are not limited to):
  - car accident
  - sudden illness or injury (Doctor’s office/hospital documented)
  - birth of a child
  - death of a family member
  - conditions of close friends (suicide, accident/injury)
  - divorce (individual and parental)

- An incomplete grade must be made up within 1 semester of being assigned regardless of residency according to the following schedule:
  - assigned fall semester: course must be completed by the end of spring semester;
  - assigned spring semester: course must be completed by the end of fall semester;
  - assigned summer semester: course must be completed by the end of fall semester.

- An I grade should not be used as a substitute for a failing grade or a withdrawal.
- Failure to complete the coursework within the timeframes defined above will result in the conversion of the I to an F.
- Incomplete grades at graduation are considered (F) grades in computing the final grade point average
- IS (in-session)—given when course remains in session after the term’s final grade deadline.
- X (conditional)—computed into the grade point average as an (F) grade given only when the student is at fault in failing to complete a segment of a course, but in the judgment of the instructor does not need to repeat the course. An X is appropriate when:
  - the student does not have a legitimate extenuating circumstance for failing to complete course requirements that meets the standards for the I grade (above);
  - the student has the ability to complete the course requirements without re-enrolling in the course;
  - the student currently has a passing grade in the course.

- Example circumstances appropriate for an X grade may include:
  - oversleeping on the day of an exam
- flat tire/unexpected car trouble
- incomplete assignments.

- X grades must be made up within the next semester according to the same schedule summarized above for the I grade. Failure to complete the course accordingly will result in the conversion of the X grade to an F.
- M (missing grade)—grade not submitted by instructor. See instructor for clarification.
- N (no grade)—no credit, no grade points; given when a student officially withdraws from the University after the regular drop period. In these cases, the registrar notifies the instructor that the student has withdrawn from the University and should receive an N grade if passing as of the date of withdrawal. The student's grade form will come to the instructor at the end of the course in the normal manner.
- P (progress)—may be used for approved 3000- or 4000-level project courses, where projects carry over for more than one semester.
- Q (inadequate progress)—may be used for approved 3000- or 4000-level project courses where projects carry over for more than one semester.
- W (late drop)—no credit, no grade points; indicates a course was dropped between the beginning of the fourth week and the end of the tenth week; after the tenth week, a student may only request a late drop from the Dean of Students Office, which will consider only those requests that clearly involve extenuating circumstances beyond the student's control.
- Cr (credit)—by advanced placement or examination.
- S (satisfactory)—credit given, no grade points, and not included in student's GPA; given for courses taken under the Pass-Fail option. A grade of S is given for work equal to letter grades of A to C.
- E (effort unsatisfactory)—no credit, no grade points; given for courses taken under the Pass-Fail option. A grade of E is given for work equal to letter grades CD to F.
- E* (effort unsatisfactory due to academic dishonesty)—no credit, no grade points; given for courses taken under the Pass-Fail option.
- V (satisfactory audit)—no credit, no grade points; given for courses taken for audit.
- U (unsatisfactory audit)—no credit, no grade points; given for courses taken for audit.
- U* (unsatisfactory audit due to academic dishonesty)—no credit, no grade points; given for courses taken for audit.

**Audit Grade Option**—Requests to change from a normal grade mode (A-F) to audit for a course must be received in the Registrar's Office by the close of business on Wednesday of the second week of the semester (the last day to add/drop a course). Audited courses may not be used to fulfill academic requirements.

**Pass-Fail Grade Option**—Requests to change from a normal grade mode (A-F) to pass-fail for a course must be received in the Registrar’s Office by the close of business on Wednesday of the second week of the semester (the last day to add/drop a course). Courses taken for a letter grade may not be repeated under the pass-fail option. Courses taken under the pass-fail option may only be used to fulfill free electives.

**Graduation Requirements**
The Michigan Tech Undergraduate Catalog is updated annually and requirements for degree programs may change from one catalog year to the next.

Students maintaining continuous enrollment at Michigan Tech may expect to graduate under the requirements published in the catalog in effect at the time of their matriculation. Students who change majors will follow the requirements in effect at the time of the change.

Students who add a major, minor, or certificate will follow the requirements for the additional curriculum in effect at the time it is added.

Students who have been absent from the University for one or more years will follow the degree requirements of the catalog in effect at the time of readmission.

Students should consult with their academic advisor for guidance when considering options in regard to their individual plan.
Graduation Residency Policy—Students must meet the following residency requirements in order to receive a baccalaureate degree from Michigan Tech:

1. Thirty of the last 36 semester credit hours of academic work to be applied to the degree must have been completed at Michigan Tech. Study abroad and co-op credits earned through Michigan Tech may be included in these 30 hours if the student has completed 30 credit hours of courses at Michigan Tech among the last 60 credit hours to be applied to the degree.
2. Thirty semester credit hours of advanced level courses (3000 or higher) must be completed at Michigan Tech.

Courses which meet the "at Michigan Tech" requirement are defined as courses listed in the course catalog and taught by Michigan Tech faculty either on campus, at field locations, or through distance learning.

Each undergraduate degree candidate is expected to:

1. Successfully complete the required courses prescribed for their chosen curriculum.
2. Successfully complete the required University General Education requirements.
3. Attain a cumulative University GPA of at least 2.00, and a major department GPA of at least 2.00.
4. Comply with Michigan Tech's graduation residency requirements.
5. File a graduation application with the Registrar's Office for each degree or certificate program the candidate intends to complete.
6. Have an approved degree audit on file with the academic advisor for each academic program in which enrolled.

Undergraduate Commencement Eligibility Requirements
Michigan Tech conducts two commencement ceremonies each year that are held in the spring and fall semesters. Students completing all degree requirements in the spring or summer will be listed for the spring commencement ceremony and students completing their degree requirements in the fall will be listed for the fall commencement ceremony. Students who find it necessary to participate in a ceremony held prior to their graduation term due to extenuating circumstances must seek approval from the assistant registrar of curriculum services in the Registrar's Office.

In order to be eligible to participate** in a commencement ceremony and to be listed in the commencement program, all degree candidates must:

- Be registered in the course(s) that will complete all outstanding program requirements.
- Have an approved audit on file with the academic advisor for each academic program in which enrolled.
- Have a graduation application on file for each degree and certificate in which enrolled in the Registrar's Office two semesters prior to the expected graduation term.

**Participation in a commencement ceremony is NOT equivalent to graduation. Since the ceremony may occur before final grades are submitted, it is not possible to determine if all degree requirements have been met at that time. Graduation becomes official after all grades are received and the degree notation is placed on the academic record.

Annual Notification of Student Rights Under the Family Educational Rights and Privacy Act (FERPA)
The Family Educational Rights and Privacy Act (FERPA) affords students certain rights with respect to their education records. These rights include:

1. The right to inspect and review the student's education records within 45 days of the day the University receives a request for access.

A student should submit to the registrar, dean, head of the academic department, or other appropriate official, a written request that identifies the record(s) the student wishes to inspect. The University official will make arrangements for access and notify the student of the time and place where the records may be inspected. If the
records are not maintained by the University official to whom the request was submitted, that official shall advise the student of the correct official to whom the request should be addressed.

2. The right to request the amendment of the student's education records that the student believes are inaccurate, misleading, or otherwise in violation of the student's privacy rights under FERPA.

   A student who wishes to ask the University to amend a record should write the University official responsible for the record, clearly identify the part of the record the student wants changed, and specify why it should be changed.

   If the University decides not to amend the record as requested, the University will notify the student in writing of the decision and the student's right to a hearing regarding the request for amendment. Additional information regarding the hearing procedures will be provided to the student when notified of the right to a hearing.

3. The right to provide written consent before the University discloses personally identifiable information from the student's education records, except to the extent that FERPA authorizes disclosure without consent.

   The University discloses education records without a student's prior written consent under the FERPA exception for disclosure to school officials with legitimate educational interests. A school official is a person employed by the University in an administrative, supervisory, academic or research, or support staff position (including law enforcement unit personnel and health staff); a person or company with whom the University has contracted as its agent to provide a service instead of using University employees or officials (such as an attorney, auditor, or collection agent); a person serving on the Board of Control; or a student serving on an official committee, such as a disciplinary or grievance committee, or assisting another school official in performing his or her tasks.

   A school official has a legitimate educational interest if the official needs to review an education record in order to fulfill his or her professional responsibilities for the University.

4. The right to file a complaint with the US Department of Education concerning alleged failures by the University to comply with the requirements of FERPA. The name and address of the office that administers FERPA is:

   Family Policy Compliance Office
   US Department of Education
   400 Maryland Avenue, SW
   Washington, DC 20202-5901

FERPA further provides that certain information designated as "Directory Information" concerning the student may be released by the University unless the student has informed the University that such information should not be released.

The University designates the following as public or "Directory Information": The student's name, address, telephone number, email address, hometown, age, college, major field of study, class (senior, junior, sophomore, freshman), student status; full-time or part-time registration or not currently enrolled, student level; undergraduate/graduate, dates of attendance, participation in officially recognized activities and sports, leadership positions at Michigan Tech, weight and height of athletic team members, specific athletic achievements, Michigan Tech job title, degrees and awards received, academic and other honors, most recent previous school attended and parent/guardian names in conjunction with university awards/recognition.

As a matter of normal practice, Michigan Technological University does not sell or release "Directory Information" to commercial third parties, unless required to do so by law.

Students may restrict the release of "Directory Information," except to school officials with legitimate educational interests and others as indicated above. To do so, a student must file a request to withhold directory information form with the Registrar's Office. Once filed, this request becomes a permanent part of the student's record until the student instructs the University, in writing, to have the request removed.

Questions about FERPA may be directed to Michigan Technological University, Registrar’s Office, 1400 Townsend Drive, Houghton, MI 49931-1295. The complete policy is available on the Registrar's Office website.
University Information and Freedom of Information Act
Michigan Tech is committed to maintaining a free exchange of information throughout the University community. It is our general practice to release most types of information immediately upon request.

In addition, as a publicly funded institution, Michigan Tech is subject to the provisions of the state and federal Freedom of Information Acts (FOIA). FOIA requires the University to provide copies of most administrative documents, with the exception of certain legal and personnel records, to anyone filing a FOIA request. If you wish to file a Freedom of Information Act request or if you would like to view University documents, contact the Office of the President at 906-487-2200.

Registration
Registration periods for each semester are listed in the University Academic Calendar.

While every effort is made to ensure that the Schedule of Classes is accurate, unforeseen circumstances or low enrollments may cause the cancellation of some section(s) or course(s). Michigan Tech also reserves the right to change the days, times, rooms, or instructors of section(s) or course(s) as deemed necessary.

The Schedule of Classes can be found on the web at Prepare for Registration.

Adding Classes—The last day to officially add a full semester course is Wednesday of the second week of the semester*.

First-year students: Through the first five days of the semester*, signature approval must be obtained from the student's academic advisor. After the fifth business day of the semester*, signature approval must be obtained from the student's academic advisor and the course instructor. Section changes for the same course do not require an academic advisor approval signature.

All other students: Through the first five business days of the semester*, no signature approval is required. After the fifth business day of the semester*, students must obtain signature approval from the course instructor to add a course or change a section.

* Or the same percentage of time if a course is offered in a time module other than a fourteen-week semester

Dropping Classes—Courses dropped by the close of business on Wednesday of the second week of the semester* will be refunded 100 percent. Courses dropped after this date will not be refunded.

During the first three weeks of a semester, courses dropped will not be recorded on the student's permanent record. Beginning the fourth week through the end of the tenth week of the semester, courses dropped will be indicated by a grade of W on the student's permanent record.

First-year students: During the first three weeks of instruction*, signature approval must be obtained from the student's academic advisor. Students must be made aware of how dropping a course affects their progress toward graduation. After the third week of instruction*, signature approval must be obtained from the student's academic advisor and the course instructor.

All other students: During the first week through the end of the tenth week of instruction*, no signature approval is required.

* Or the same percentage of time, if a course is offered in a time module other than a fourteen-week semester.

After the tenth week of a semester, a student may request a late drop from the Dean of Student's Office which will consider only those requests that clearly involve extenuating circumstances beyond a student's control. The course will appear on the student's transcript with a grade of W.

NOTE: Students who drop all of their classes will be withdrawn from school as of the date those classes were dropped.
Financial Obligations—Having fulfilled all other requirements, a student is eligible for registration or graduation only if all financial obligations to the University have been met. Students with an outstanding balance will have a hold placed on their account. This hold denies access to registration and prevents the distribution of grades and transcripts.

Variable Credit Courses—The last day to change credit amounts on variable credit courses is Wednesday of the second week of the semester (or the same percentage of time if a course is offered in a time module other than a fourteen-week semester). Decreases in credits after this date will not be refunded.

Prerequisites—Prerequisite courses are required to be satisfactorily completed before a student may register in a course requiring the prerequisite. Students who earn a CD or D in a prerequisite course should retake the prerequisite course before registering for the advanced course.

Concurrent prerequisite: a prerequisite that may be taken the same semester as the course requiring it.

Corequisites: courses that are required to be taken together in the same semester.

The course instructor has the right to waive a prerequisite in the case of a student who has demonstrated competence or who has academic experience equivalent to that represented by the prerequisite. The waiver does not grant credit for the prerequisite course, but indicates the instructor's willingness to accept the student into class without the student officially taking the prerequisite course.

Repeating a Course—Undergraduate students may not repeat courses in which they have earned a grade of C or better. When a course is repeated, the most recent grade will be used to calculate the GPA, credits earned toward graduation, and determination of class standing. Any credit previously earned under the course number is forfeited and the transcript will indicate NR (No grade-repeated) for the earlier attempt. Students must have the permission of the dean of students and their academic advisor for the third attempt at any one course. Courses exempt from the repeat rule are those that may be repeated for credit as indicated in the course description.

In situations where an original course is no longer offered and no active direct equivalent exists, students may seek the permission of their academic advisor and their department chair or school dean to substitute a different course (a "similar repeat") that covers comparable material at a similar level.

Curriculum Changes—Undergraduate students considering a change of major should initially contact the prospective major department for information regarding restrictions or requirements for being admitted into that department. All changes are recorded on the Curriculum Add/Drop form, available in the department academic advising offices. The student must complete the form, have it signed by the appropriate academic advisor, and submit it to the Registrar’s Office before Wednesday of the second week of instruction to be effective for that semester. Curriculum changes received after that time will be effective for the following semester.

In addition to changing a primary major, the Curriculum Add/Drop form can be used to add, drop, or change a concentration, minor, a double major, or a second degree. Questions may be directed to registrar@mtu.edu.

Download Curriculum Add/Drop form.

Enrollment in Graduate Courses under "Senior Rule"—While completing an undergraduate degree, students are permitted to take courses which could apply to a graduate degree. However, a course cannot be applied to both a graduate and an undergraduate degree.

A Senior Rule form must be completed and submitted to the Registrar’s Office by Wednesday of the second week of class for the term in which the class is taken. Upon submission, the student's academic record will be changed to show graduate status for the course(s) designated. Once the academic record has been changed to show graduate status for a particular course, it cannot be changed back to count toward an undergraduate degree, nor can courses from previous semesters be reclassified.

Students will receive two transcripts once the Senior Rule is applied to a course—one for undergraduate courses and one for graduate courses. Courses completed previously under Senior Rule (but not classified as such in the student's academic record) will not be reclassified to appear on the graduate transcript, but the courses may be accepted on the graduate degree schedule with department advisor's approval.
**Withdrawing from the University**

**Withdrawal Procedure**—Students withdrawing from the University will have their tuition assessed based on the [Withdrawal Refund Schedule](#). Failure to withdraw will result in F grades and in payment of tuition and fees which otherwise may be avoided.

Complete the [Withdrawal Form](#) and bring to the Dean of Students Office in the Administration Building.

If you live in on-campus housing, remember to contact the Housing and Residential Life Office (906-487-2682) regarding your withdrawal.

**Withdrawal of Students Called to Active Military Service**—Students called to active duty are guaranteed readmission upon completion of active service. Enrolled Michigan Tech students who are called to active military duty will be given the opportunity to work out the best possible solution for maintaining their academic status. They must choose one of the following options before departing for active service:

- Leave for active service with a tuition refund of 100 percent. Refunds involving financial aid will be adjudicated to decrease the payback required from the student to the lowest possible amount.
- Agree that temporary grades will be issued for enrolled courses. The temporary grades will be P for Progress or I for Incomplete. In some cases, arrangements can be made to complete the course work while on active duty. Otherwise, the student may complete the courses when he or she returns to the University.

**Involuntary Medical Withdrawal**—A student will be subject to involuntary withdrawal if the University Medical and Mental Health Board recommends, in the members’ professional judgment, and the dean accepts the recommendation, that the student is suffering from a mental, emotional, psychological, or physical health disorder and, as a result of this disorder engages, or threatens to engage, in behavior that would cause significant property damage or directly and substantially impede the lawful activities of others.
General Education Goals

General Education is an important and required component of every Michigan Tech degree. Accreditation by the Higher Learning Commission requires that general education “imparts broad knowledge and intellectual concepts to students and develop skills and attitudes that the institution believes every college-educated person should possess.” At Michigan Tech, the General Education program enables all students, regardless of major, to develop an understanding of science and the social and cultural contexts of our contemporary world. The goals of the General Education program are included in the University Student Learning Goals:

- Knowledge of the physical and natural world
- Global literacy
- Critical and creative thinking
- Communication
- Information literacy
- Social responsibility and ethical reasoning

General Education Curriculum

The General Education curriculum consists of the following requirements:

- Core courses (12 credits)
- Humanities, Arts, and Social Sciences (HASS) requirement (12 credits)
- Science, Technology, Engineering and Math (STEM) requirement (15 credits)
- Cocurricular activities (3 semester units, typically 6 half-credit classes)

General Education Requirements

General Education requirements are not normally waived, substituted, or modified. Advisors may submit requests if students have received incorrect advice. Requests are reviewed on an individual basis by the General Education Council.

Core Courses (12 credits) The core courses emphasize developing competencies in the six General Education Learning Goals.

- Composition (UN1015) - 3 credits. This first-year writing intensive course emphasizes developing competencies in communication and information literacy.

- Global Issues (UN1025) - 3 credits. This first-year course emphasizes understanding human cultures and developing competencies in global and information literacy.

  or Modern Language Option for Global Issues. A 3000 level language course or higher may be used in place of UN1025 Global Issues. Students with prior language background who have completed Michigan Tech's WebCape modern language placement exam online must take the validation course on campus and receive a grade of B or higher to receive advanced placement credit for lower level language courses. Students with transfer or AP language credit, or who plan to study abroad, should see the Humanities Department modern language director for advice.

- Goal 4 Critical and Creative Thinking - 2000-level courses. Students must take 3 credits from the Goal 4 list.

- Goal 8 Social Responsibility and Ethical Reasoning - 2000-level courses. Students must take 3 credits from the Goal 8 list.
HASS (Humanities, Arts, Social Sciences) (12 credits; prior to Fall 2013, 15 credits)
Students must take 12 credits from the Humanities, Arts, and Social Sciences (HASS) list as follows:

- 3 credits from each of the following:
  - Composition or Communication (3 credits)
  - Humanities or Fine Arts (3 credits)
  - Social/Behavioral Sciences (3 credits)
  - Any HASS or HASS Restricted list (3 credits)

- 6 credit hours must be at the 3000 or 4000 level.
  - No more than 3 credits from the HASS Restricted list may be used to satisfy HASS requirements.
  - Courses that appear on both HASS and STEM lists can only be counted once on a degree audit.
  - Each course can satisfy only one requirement.

Science, Technology, Engineering, Mathematics (STEM) Requirement (15 credits; prior to Fall 2015, 16 credits)
Students must take a minimum of 15 credits of Science, Technology, Engineering, and Mathematics from the STEM list, with the following conditions:

- At least 4 credits from the Mathematics list
- At least 7 credits from the Science list
  - At least two courses
  - Courses in two different disciplines
  - One course must be taken with the accompanying laboratory

- No more than 4 credits from the STEM Restricted list may be used to satisfy STEM requirements.
- Courses that appear on both HASS and STEM lists can only be counted once on a degree audit.

Some degree programs specify some or all of the STEM credits. Students should check with their academic advisor for major-specific requirements.

Cocurricular Requirement (3 units)
Three cocurricular Activities units are required for graduation. A unit involves the same time commitment as an academic semester credit but is not included in calculation of the GPA or in the overall degree-credit requirement. Repeatable courses may not be repeated for cocurricular general education credit. Please note that most physical education activities will last for seven and one-half weeks, or one-half semester. A student would need six of these 0.5-semester units to fulfill the 3-semester-unit cocurricular requirement. Some ROTC courses are also approved for cocurricular activity, and a few of these (and a few PE courses) are a full semester in length and count for 1 semester unit. These are identified in the Cocurricular list.

As a part of the cocurriculum, titles of activities successfully completed will appear on the student’s transcript with a pass/fail grade. These hours will be included as “earned hours” but will not be included in “GPA hours.”

Enrollment in a cocurricular activity will count toward satisfactory progress for financial aid purposes and toward status as a full-time student. Some cocurricular activities may have lab fees.

International Study Abroad for General Education Courses
General Education International transfer credit for study abroad students (students with transfer credit from institutions outside of the US) will be assigned by International Programs and Services (IPS). It is understood that IPS will apply non-Michigan Tech courses to distribution based on their being equivalent or congruent with existing general education distribution courses.
**Transfer credit**

Students are permitted to transfer courses from other institutions to satisfy these requirements. Students **must** check with the [Michigan Tech Transfer Services Office](#) to find out which courses qualify for transfer from a specific institution **before** a class is taken off-campus.

**Michigan Transfer Agreement**

The [Michigan Transfer Agreement (MTA)](#) is for students transferring to Michigan Technological University from Michigan community colleges. All 30 credits of the MTA must be completed for students to be eligible for general education credit based on the MTA.
## General Education: Core and Humanities, Arts and Social Sciences (HASS)
### 2015-2016

### Core Courses (12 credits)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>UN1015</td>
<td>Composition</td>
<td>3</td>
</tr>
<tr>
<td>UN1025</td>
<td>Global Issues or Modern Language-3000 level or higher</td>
<td>3</td>
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</tbody>
</table>

### Goal 4 – Critical and Creative Thinking (3 credits)

- FA2330 Art Appreciation
- FA2520 Music Appreciation
- FA2720 Audio Arts Appreciation
- FA2820 Theatre Appreciation
- HU2130 Introduction to Rhetoric
- HU2503 Literary Survey A
- HU2504 Literary Survey B
- HU2538 British Experience in Literature
- HU2700 Introduction to Philosophy
- HU2820 Communication and Culture
- HU2910 Language and Mind
- SS2300 Environment and Society

### Goal 8 – Social Responsibility & Ethical Reasoning (3 credits)

- EC2001 Principles of Economics
- PSY2000 Introduction to Psychology
- SS2100 Introduction to Cultural Anthropology
- SS2200 Introduction to Archaeology
- SS2400 Introduction to Human Geography
- SS2500 United States History to 1877
- SS2501 US History Since 1877
- SS2502 European History to 1650
- SS2503 European History Since 1650
- SS2504 World History to 1500
- SS2505 World History Since 1500
- SS2600 American Government and Politics
- SS2610 Introduction to Law and Society
- SS2700 Introduction to Sociology

### Humanities, Arts, and Social Sciences (HASS) (12 credits)

Students must take **12 credits** from the HASS Electives (Humanities, Arts, and Social Sciences) with the following limitations:

- 6 credits must be upper division (3000-4000) level courses
- 3 credits are required from each of the following lists:
  - Communication/Composition
  - Humanities/Fine Arts (HU/FA)
  - Social and Behavioral Science (EC/PSY/SS)
- No more than 3 credits from the Restricted List
- Each course can satisfy only one requirement

### International Study Abroad for HASS Courses

General Education international transfer credit, for students who participate in an international study abroad experience, will be assigned by International Programs and Services (IPS). It is understood that IPS will apply non-MTU courses based on their being equivalent or congruent with existing general education courses.

### Communication/Composition

- at least 3 credits

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<tr>
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<th>Course Title</th>
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<tbody>
<tr>
<td>HU2810</td>
<td>Research &amp; Writing in Communication</td>
<td>3</td>
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<tr>
<td>HU2830</td>
<td>Public Speaking &amp; Multimedia</td>
<td>3</td>
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<tr>
<td>HU3015</td>
<td>Advanced Composition</td>
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<td>HU3120</td>
<td>Technical and Professional Communication</td>
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<td>HU3151</td>
<td>The Rhetoric of Everyday Texts</td>
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<td>HU3832</td>
<td>Advanced Digital Presentation</td>
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<td>HU4628</td>
<td>Usability and Instructions Writing</td>
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<td>Science Writing</td>
<td>3</td>
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<tr>
<td>HU4694</td>
<td>Grant Writing</td>
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### Humanities/Fine Arts (HU/FA)

- at least 3 credits

<table>
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<tr>
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<td>Creative Drawing</td>
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<td>FA2222</td>
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<td>FA2300</td>
<td>Two-Dimensional Design</td>
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<td>Beginning Wheel Throwing</td>
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<td>Color and Meaning</td>
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<td>Art Appreciation</td>
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<td>Music Appreciation</td>
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<td>Beginning Acting</td>
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<td>Audio Arts Appreciation</td>
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<td>Theatre Appreciation</td>
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<td>FA3133</td>
<td>Contemporary Music: The Search for New Sounds</td>
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<td>Art History-Renaissance to Today</td>
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<td>History of Jazz</td>
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<td>History of Rock</td>
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**Social and Behavioral Science (EC/PSY/SS)**

- at least 3 credits

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<td>Game Theory/Strategic Behavior</td>
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<td>Banking and Financial Institutions</td>
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Gen Ed List 2015-16, Page 2 of 3
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**HASS Restricted List**

- no more than 3 credits

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<td>ED3510</td>
<td>Communicating Science I</td>
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**Approved Transfer Electives**

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<td>EC9300U</td>
<td>EC HASS Elective Upper</td>
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<td>FA9300L</td>
<td>FA HASS Elective Lower</td>
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Science, Technology, Engineering and Mathematics (STEM) Courses
2015-2016 Academic Year

Students must take a minimum of 15 credits of Science, Technology, Engineering, and Mathematics (STEM) with the following conditions:

- Students must complete a minimum of 4 credit hours from the Mathematics List.
- Students must complete two science courses, in two different disciplines, from the Science Course List; at least one of these must include or be taken with the accompanying laboratory.
- No more than 4 credit hours may be counted from the Restricted STEM Course List. Courses may not count toward both STEM requirements and General Education requirements.

Some degree programs specify some or all of these STEM credits. Students should check with their academic advisor for specific requirements.

Mathematics List
Students must complete a minimum of 4 credit hours from the Mathematics List.

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<td>MA1020</td>
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<td>MA1031</td>
<td>College Algebra II with Trigonometry</td>
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<td>Precalculus</td>
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<td>MA1135</td>
<td>Calculus for Life Sciences</td>
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<tr>
<td>MA1160</td>
<td>Calculus with Technology I</td>
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<td>Calculus Plus with Technology I</td>
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<td>Statistical Methods</td>
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Science Course List
Students must complete any two science courses (in two different disciplines) from this list. At least one of these must also include a laboratory component, or be taken along with the accompanying laboratory course. Courses or course-groups satisfying the laboratory requirement are designated by *.

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<td>BL2160*</td>
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<td>Current Health Issues</td>
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<td>BL4090</td>
<td>Tropical Island Biology</td>
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<tr>
<td>CH1112*</td>
<td>University Chemistry – Studio Lab I</td>
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<td>CH1150*</td>
<td>University Chemistry I (plus CH1151/1153)</td>
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<td>Lifetime Fitness</td>
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<td>Wetlands</td>
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<td>FW4240*</td>
<td>Mammalogy</td>
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<td>Understanding the Earth</td>
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<td>Applied College Physics I (plus PH1141)</td>
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<td>Honors Physics I – Mechanics (plus PH1161 or PH1100)</td>
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<td>Introductory Astronomy (plus PH1610**)</td>
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<td>University Physics I-Mechanics (plus PH1100)</td>
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**This laboratory is optional with the associated course. If the laboratory is not taken, the associated course can count as a science course for General Education STEM requirements, but does not satisfy the requirement of taking at least one laboratory course.

Restricted STEM Courses
No more than 4 credit hours may be counted from the following list of courses. Courses may not count on a degree audit toward both STEM requirements and General Education requirements.

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<td>University Chemistry Studio Laboratory II ***</td>
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<td>Introduction to Programming I</td>
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<td>Introduction to Programming II</td>
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Any course at the 2000-level or higher in the following STEM disciplines (with the exception of BE2100).

* Biology (BL)
  - Chemistry (CH)
  - Computer Science (CS)
  - Engineering (BE, CE, CM, EE, ENG, ENVE, GE, MEEM, MY, SSE)
  - Forestry (FW)
  - Geology (GE)
  - Mathematics (MA)
  - Physics (PH)
  - Technology (EET, MET, SAT, SU, TE)

**NOTE that a maximum of 4 credits will count toward STEM requirements.
Three co-curricular units are required for graduation. A unit involves the same time commitment as an academic semester credit but is not included in calculation of the GPA, nor in the overall degree-credit requirement. Repeatable courses may not be repeated for co-curricular general education credit.

As part of the co-curriculum, titles of courses successfully completed will appear on the student's transcript with a pass/fail grade. These hours will be included as "earned hours" but will not be included in "GPA hours."

Enrollment in a co-curricular activity will count toward satisfactory progress for financial aid purposes and toward status as a full-time student.

### Co-curricular Courses

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*PE0210 may only be repeated once for general education co-curricular credit if topics are different. PE0425 may also be repeated once for general education co-curricular credit.*
## Curriculum Codes AY2015-2016, Revised 8/24/2015

### Academic Program Codes

#### School of Business and Economics

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### Geology and Mining Engineering and Sciences

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| **Secondary Education-Teacher Cert Majors** | |
| Biological Sciences (Conc SBL7) | TED2 |
| Chemistry (Conc SCH3) | TED3 |
| Computer Science (Conc SCS4) | TED9 |
| Earth and Space Science and Integrated Science (Conc EGS3) | TED4 |
| Economics (Conc BEC2) | TEDC |
| English (Con SEN1) | TEDA |
| Integrated Science (BS in FES or Engineering) | TEDI |
| Mathematics (Con SMA7) | TED6 |
| Medical Laboratory Science (Conc SML0) | TEDL |
| Physics (Con SPH1 or SPA1) | TED8 |
| Social Sciences (Con SSS2) | TED5 |

| **Secondary Education-Teacher Cert Minors** | |
| (Must be enrolled in Teaching Certification Program) | |
| Biological Sciences | TEDM |
| Chemistry | TEDN |
| Computer Science | TEDO |
| Economics | TEDQ |
| English | TEDR |
| Mathematics | TEDS |
| Physics | TEDT |

| **Administrative Major Codes** | |
| Educational Opportunities | PEO |
| English as a Second Language | IESL |
| Non-Degree Seeking (Undergraduate level) | NDS |
| Post-Degree Studies | PDS |
| State Teaching Certification (currently pursuing degree) | STEC |
| State Teaching Certification (degree already earned) | PTC |
| Non-Degree Seeking (Graduate level) | NDG |

Curriculum Codes AY2015-2016, Revised 8/24/2015
Good Standing: All GPAs (semester, cumulative, & departmental*) are 2.0 or greater

00 – Student has never been on probation
01 – Good standing restored after first suspension/reinstatement
02 – Good standing restored after second suspension/reinstatement
03 – Good standing restored after a period of probation – no previous suspension

Academic Probation: Any (semester, cumulative, or departmental*) GPA below 2.0

P1 – First semester probation – no previous suspension
P2 – Second semester probation – cumulative GPA above 2.0
A1 – Student granted an additional semester of probation, on appeal, after meeting conditions for first suspension

R1 – First semester probation after first reinstatement
P3 – Second semester probation after first reinstatement – cumulative GPA above 2.0
A2 – Student granted an additional semester of probation, on appeal, after meeting conditions for second suspension

R2 – First semester probation after second reinstatement
P4 – Second semester probation after second reinstatement – cumulative GPA above 2.0
A3 – Student granted an additional semester of probation, on appeal, after meeting conditions for dismissal

Academic Suspension/Dismissal: Student’s cumulative GPA is below 2.0 after a semester of academic probation or student is not restored to good academic standing after two semesters of probation regardless of the cumulative GPA

D1 – First suspension – Student may apply for reinstatement after one semester, plus a summer of non-enrollment
D2 – Second suspension – Student may apply for reinstatement after two semesters, plus a summer of non-enrollment
D3 – Dismissal – There is no reinstatement after two previous suspensions

*At least 16 credits in department
8/02
Undergraduate Course Descriptions
Effective Fall 2015

Accounting

ACC 2000 - Accounting Principles I
Introduction to basic principles, concepts, and theoretical framework of financial accounting with the emphasis on its use by economically rational decision makers. Topics include the decision-making environment and the accounting cycles, processes, and statements.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring, Summer

ACC 2100 - Accounting Principles II
Emphasizes the role of accounting information within a firm. Topics include budgeting, responsibility accounting, cost allocations, cost behavior, decision models, capital budgeting, and an introduction to product costing in manufacturing and service sector firms.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring, Summer

ACC 3000 - Accounting Theory/Practice I
Studies the theory, concepts, and practices underlying financial accounting and measurement. Primary focus is on income measurement, and the valuation of assets, like cash, receivables, inventory, and long-lived assets, as well as multinational issues.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): ACC 2000

ACC 3100 - Accounting Theory/Practice II
A continuation of ACC 3000 with theories, concepts, and practices underlying financial measurement and reporting. Focuses on the measurement and reporting of liabilities and equities, and includes multinational issues.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): ACC 2000

ACC 3500 - Managerial/Cost Accounting I
The primary emphasis is on traditional and contemporary product costing techniques, cost allocation practices, and basic cost-management issues. Topics include process costing, standard costing, activity-based costing, backflush costing, cost allocation issues, balanced scorecard, strategic profitability analysis, and the role of accounting in contemporary management practices.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): ACC 2000

ACC 3600 - Foundations of Taxation
Introduction to basic principles, concepts, and theoretical framework of taxation systems, emphasizing income taxation and its impact on decision making. Topics include tax planning and compliance for individuals, corporations, and partnerships.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): ACC 2000

ACC 4500 - Managerial/Cost Accounting II
Emphasizes information requirements of contemporary management decision-making and strategic-planning processes. Covers contemporary control and evaluation practices (such as activity-based management), determining the costs of quality, and productivity analysis in the context of accounting information systems.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): ACC 3500

ACC 4600 - Advanced Tax Topics
Continuation of ACC3600. Introduction to advanced principles and concepts of taxation, emphasizing income taxation and its impact on decision making. Topics include tax planning and compliance for estates and trusts, gratuitous transfers, multi-jurisdictional operations, and entity formations, liquidations, and reorganizations.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): ACC 3600

ACC 4700 - Governmental and Not-for-Profit Accounting
An in-depth study of the accounting principles and financial reporting unique to the governmental and not-for-profit sectors of the U.S. economy.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): ACC 3100

ACC 4800 - Accounting Systems
Introduction to the basic principles, concepts, and theoretical framework for the design and operation of accounting information systems, emphasizing its use to enhance decision making. Topics include system design, internal controls, the use of databases, and electronic commerce.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): ACC 2100 or ACC 5050

ACC 4990 - Special Topics in Accounting
Examines current issues in Accounting and other topics of interest to faculty and students in greater depth.
Credits: variable to 3.0; Repeatable to a Max of 6
Semesters Offered: On Demand
Restrictions: Permission of instructor required
Pre-Requisite(s): ACC 3310

Air Force ROTC

AF 0120 - Physical Conditioning
Activities that promote physical conditioning. Emphasis is on individual conditioning through strength and aerobic training and team sports such as ultimate frisbee and football. May be used once as a general education co-curricular course. Non-performance. Each student must have or purchase an appropriate drill-team uniform. May be used once as a general education co-curricular course. Non-performance. Each student must have or purchase an appropriate drill-team uniform.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Spring

AF 0130 - Air Force Elite Forces Workout
An intense workout program that develops personal physical fitness and self-confidence. Workouts include an elite U.S. Military special operations training. Basic swimming skills required.
Credits: 1.0; Graded Pass/Fail Only
Lec-Rec-Lab: (-0-0-2)
Semesters Offered: Spring
Restrictions: Permission of instructor required

AF 0230 - Precision Drill Team
Techniques and skills involved in precision drill movements, including marching, rifle spinning, ceremonial sabre handling, and color guard performance. Each student must have or purchase an appropriate drill-team uniform. May be used once as a general education co-curricular course. Non-cadets are required to provide a uniform cleaning deposit and purchase some non-returnable uniform items.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall
Restrictions: Permission of instructor required
AF 0340 - Field Training
A rigorous program of physical conditioning, team activities, and survival training. Offered the summer semester after acceptance into the Field Training program. Course completed off campus.
Credits: 1.0; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Summer
Restrictions: Permission of instructor required

AF 1001 - Foundations of US Air Force I
Introduces students to the USAF and ROTC. Topics include Air Force mission and organization, officership, professionalism, military customs and courtesies, officer opportunities, and communication skills. Leadership Laboratory is mandatory for AFROTC cadets and complements this course by providing cadets with followership experiences.
Credits: 1.0
Lec-Rec-Lab: (0-1-2)
Semesters Offered: Fall

AF 1002 - Foundations of US Air Force II
Introduces students to the USAF and ROTC. Topics include Air Force mission, organizations, officership, professionalism, military customs, courtesies, officer opportunities, and communication skills. Leadership Laboratory is mandatory for AFROTC cadets and complements this course by providing cadets with followership experiences.
Credits: 1.0
Lec-Rec-Lab: (0-1-2)
Semesters Offered: Spring

AF 2001 - Evolution of US Air & Space Power I
This course examines the history of United States air and space power from the first balloons and dirigibles up to the Korean War through key events and personalities. The course looks at United States air and space power in the context of the international political scene in war and peace. The role of women and minorities in the evolution of United States air and space power is highlighted.
Credits: 1.0
Lec-Rec-Lab: (0-1-2)
Semesters Offered: Fall

AF 2002 - Evolution of US Air & Space Power II
This course examines the history of United States air and space power from post-Korean War to the present through key events and personalities. The course looks at United States air and space power in the context of the international political scene in war and peace. The role of women and minorities in the evolution of United States air and space power is highlighted.
Credits: 1.0
Lec-Rec-Lab: (0-1-2)
Semesters Offered: Spring

AF 2010 - Evolution of US Air And Space Power I for Non-AFROTC Students
For non-AFROTC students, AFROTC cadets should enroll in AF2001. This course examines the history of United States air and space power from the first balloons and dirigibles up to the Korean War through key events and personalities. The course looks at United States air and space power in the context of the international political scene in war and peace. The role of women and minorities in the evolution of United States air and space power is highlighted.
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall
Restrictions: Permission of instructor required

AF 2020 - Evolution of US Air and Space Power II for Non-AFROTC Students
For non-AFROTC students, AFROTC cadets should enroll in AF2002. This course examines the history of United States air and power from post-Korean War to the present through key events and personalities. The course looks at United States air and space power in the context of the international political scene in war and peace. The role of women and minorities in the evolution of United States air and space power is highlighted.
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Spring
Restrictions: Permission of instructor required

AF 3001 - Leadership Studies I
Study and practice of leadership in civilian and military organizations. Topics include leadership principles, problem solving, management fundamentals, counseling, motivation, mentoring, and effective communication. Various leadership theories are discussed. The course includes discussion, informal lecture, case studies, self-evaluation of leadership traits, and experiential exercises.
Credits: 3.0
Lec-Rec-Lab: (0-2-3)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

AF 3002 - Leadership Studies II
Study of leadership in civilian and military institutions. Topics include leadership ethics, professional relations, and communication skills. The course includes discussion, informal lecture, case studies, and experiential exercises.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

AF 3010 - Leadership Studies I for Non-AFROTC Students
For non-AFROTC students, AFROTC cadets should enroll in AF3001. Study and practice of leadership in civilian and military organizations. Topics include leadership principles, problem solving, management fundamentals, counseling, motivation, mentoring, and effective communication. Various leadership theories are discussed. The course includes discussion, informal lecture, self-evaluation of leadership traits, and experiential exercises.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Restrictions: Permission of instructor required; May not be enrolled in one of the following Class(es): Freshman

AF 3020 - Leadership Studies II for Non-AFROTC Students
For non-AFROTC students, AFROTC cadets should enroll in AF3002. Study of leadership in civilian and military institutions. Topics include leadership principles, problem solving, management fundamentals, counseling, motivation, mentoring, and effective communication. Various leadership theories are discussed. The course includes discussion, informal lecture, self-evaluation of leadership traits, and experiential exercises.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

AF 4001 - National Security Affairs I
This course is designed to develop an understanding of the nature of conflict and how the United States military forces are developed, organized, and employed. Topics include the need for national security, the evolution and formulation of American defense policy and strategy, the origins of regional security issues, cross cultural competence, and joint doctrine.
Credits: 3.0
Lec-Rec-Lab: (0-2-3)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

AF 4002 - National Security Affairs II
This course examines selected roles of the military in society, unconventional warfare, current issues affecting the military profession, and the military justice system. Special topics of interest focus on information warfare, the law of armed conflict, the military as a profession, and officership.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

AF 4010 - National Security Affairs I - for Non-AFROTC Students
For non-AFROTC students, AFROTC cadets should enroll in AF4001. This course is designed to develop an understanding of the nature of conflict and how the United States military forces are developed, organized, and employed. Topics include the need for national security, the evolution, and formulation of American defense policy and strategy, the origins of regional security issues, cross cultural competence, and joint doctrine.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Restrictions: Permission of instructor required; May not be enrolled in one of the following Class(es): Freshman, Sophomore

AF 4020 - National Security Affairs II - for Non-AFROTC Students
For non-AFROTC students, AFROTC cadets should enroll in AF4002. This course examines selected roles of the military in society, unconventional warfare, current issues affecting the military profession, and the military justice system. Special topics of interest focus on information warfare, the law of armed conflict, the military as a profession, and officership.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Restrictions: Permission of instructor required; May not be enrolled in one of the following Class(es): Freshman, Sophomore
Army ROTC

AR 0340 - Internship in Advanced Military Leadership
A rigorous program of physical conditioning, leadership development, and team building training. Offered the summer semester after completion of the Cadets junior year of college. Course completed off campus. Credit: 3.0; Graded Pass/Fail Only.

AR 1001 - Introduction to the Army and Critical Thinking
Introduces cadets to the competencies that are critical for effective leadership. Cadets learn how the personal development of "life skills" such as critical thinking, time management, goal setting, stress management, and comprehensive fitness relate to the Army profession. Credit: 1.0

AR 1003 - Introduction to the Profession of Arms and Professional Competence
Introduces Cadets to the competencies that are critical for adaptive leadership. Cadets learn the basics of the communication process and the importance of developing the essential skills to effectively communicate in the Army. Students will examine the Army profession in depth. Credit: 1.0

AR 1011 - Basic Leadership Lab I
Practicum in basic military topics such as drill and ceremony, emergency preparedness, survival skills, and military communication. Credit: 1.0

AR 1012 - Basic Leadership Lab II
Practicum in basic military topics such as first aid, teambuilding, orienteering, profession of arms, and ethics in problem solving. Credit: 1.0

AR 2001 - Leadership and Decision Making
Explores the dimensions of creative tactical leadership styles by examining team dynamics and historical leadership theories that form the basis of the Army leadership framework. Aspects of motivation and team building are practiced through planning, executing, and assessing team exercises. Credit: 1.0

AR 2002 - Army Doctrine and Team Development
Examines the challenges of leading teams in complex operational environments. The course highlights terrain analysis, patrolling, and operation orders. Cadets develop greater self-awareness as they assess their own leadership styles and practice communication and team building skills. Credit: 1.0

AR 2011 - Intermediate Leadership Lab I
Practicum in basic military topics, such as drill and ceremony, emergency preparedness, survival skills, and military communication. Credit: 1.0

AR 2012 - Intermediate Leadership Lab II
Practicum in basic military topics, such as first aid, teambuilding, orienteering, profession of arms, and ethics in problem solving. Credit: 1.0

AR 2068 - Fall Military Physical Conditioning
Develops physical fitness, personal confidence, self-esteem and military skills. Students are exposed to both individual and group physical fitness procedures and techniques. Emphasis is on developing a good fitness program for each individual student. May be used once as a general education co-curricular course. Credit: 1.0; Repeatable to a Max of 12; Graded Pass/Fail Only.

AR 2069 - Spring Military Physical Conditioning
Develops physical fitness, personal confidence, self-esteem and military skills. Students are exposed to both individual and group physical fitness procedures and techniques. Emphasis is on developing a good fitness program for each individual student. May be used once as a general education co-curricular course. Credit: 1.0; Repeatable to a Max of 12; Graded Pass/Fail Only.

AR 3001 - Platoon Operations
Challenging scenarios related to small unit tactics are used to develop self awareness and critical thinking skills. Cadets receive systematic and specific feedback on their leadership activities. Cadets begin to analyze and evaluate their own leadership values, attributes, skills and actions. Credit: variable to 3.0

AR 3002 - Applied Leadership in Platoon Operations
Uses intense situational leadership challenges to build cadet skills in leading small units. Skills in decision-making, persuading, and motivating team members are explored, evaluated, and developed. Emphasis is also placed on developing and issuing operations orders. Credit: variable to 3.0

AR 3011 - Advanced Leadership Lab I
Practicum in basic military topics, such as drill and ceremony, emergency preparedness, survival skills, and military communication. Credit: 1.0

AR 3012 - Advanced Leadership Lab II
Practicum in basic military topics, such as first aid, teambuilding, orienteering, profession of arms, and ethics in problem solving. Credit: 1.0

AR 3068 - Military Physical Leadership I
Develops a cadet's leadership abilities to design, implement, and assess a platoon level Army physical training program. Cadets learn the basic leadership of designing and developing a physical conditioning program. May be used once as a general education co-curricular course. Credit: 1.0; Repeatable to a Max of 12; Graded Pass/Fail Only.

AR 3069 - Military Physical Leadership II
Develops a cadet's leadership abilities to design, implement, and assess a platoon level Army physical training program. Cadets improve their small group's level of physical conditioning while honing their own leadership skills. May be used once as a general education co-curricular course. Credit: 1.0; Repeatable to a Max of 12; Graded Pass/Fail Only.

AR 3100 - Special Topics Small Group Leadership
Study and discussion of topics in Military Leadership not included in regular undergraduate courses. Credit: variable to 3.0

AR 3101 - Special Topics Small Group Leadership
Study and discussion of topics in Military Leadership not included in regular undergraduate courses. Credit: variable to 3.0

AR 3100 - Special Topics Small Group Leadership
Study and discussion of topics in Military Leadership not included in regular undergraduate courses. Credit: variable to 3.0

AR 3775 - U.S. Military History for the Professional Officers
History of the American military and its place in American society in both peace and war from the colonial period until the present. Credit: 3.0

Credits: 1.0; Repeatable to a Max of 12; Graded Pass/Fail Only.

Credits: 1.0; Repeatable to a Max of 12; Graded Pass/Fail Only.

Credits: 1.0; Repeatable to a Max of 12; Graded Pass/Fail Only.

Credits: 1.0; Repeatable to a Max of 12; Graded Pass/Fail Only.
AR 4001 - Mission Command I and the Army Profession
Introduces Cadets to the challenges of mission command and gaining an understanding of the Army profession. Cadets learn the basics of mission command and how it is used in Army operations. Students will examine the Army profession in depth.
Credits: variable to 3.0
Semesters Offered: Spring
Co-Requisite(s): AR 4011
Pre-Requisite(s): AR 3001 and AR 3002

AR 4004 - Mission Command II and the Company Grade Officer
Continued exploration of mission command and gaining an understanding of the Army profession. Cadets learn the basics of mission command and how it is used in Army operations. Students will examine the Army profession in depth.
Credits: variable to 3.0
Semesters Offered: Fall, Spring
Co-Requisite(s): AR 4012
Pre-Requisite(s): AR 3001 and AR 3002

AR 4011 - Battalion Staff Operations I
Develops personal confidence and advanced leadership ability using basic and advanced military skills. Students are given responsibility for planning and controlling the activities of the cabaret battalion. Applied creativity, problem solving, decision making, and leadership are the cornerstones of this course.
Credits: 1.0
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall
Co-Requisite(s): AR 4001

AR 4012 - Battalion Staff Operations II
Develops personal confidence and advanced leadership ability using basic and advanced military skills. Students are given responsibility for planning and controlling the activities of the cabaret battalion. Applied creativity, problem solving, decision making, and leadership are the cornerstones of this course.
Credits: 1.0
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Spring
Co-Requisite(s): AR 4004

AR 4100 - Special Topics Leadership Development
Study and discussion of topics in Military Leadership not included in regular undergraduate courses.
Credits: variable to 3.0
Semesters Offered: On Demand
Restrictions: Permission of department required; May not be enrolled in one of the following Class(es): Freshman, Sophomore

Atmospheric Science

ATM 4640 - Fundamentals of Atmospheric Science
Fundamental principles of atmospheric science, including thermodynamics, aerosol and cloud physics, radiative transfer, and atmospheric dynamics.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2015-2016 academic year
Pre-Requisite(s): (PH 2200 or PH 2260) and (PH 1360 or PH 2300) and MA 3160 and (MA 3520 or MA 3521 or MA 3530 or MA 3560)

Biomedical Engineering

BE 2100 - Undergraduate Biomedical Engineering Seminar
An overview of biomedical engineering designed especially for freshmen and sophomores that includes presentations by faculty, members of the community and other guest lecturers. Topics ranging from clinical engineering through basic biomedical engineering research are covered.
Credits: 1.0; Graded Pass/Fail Only
Lec-Rec-Lab: (1-0-0)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Level(s): Graduate; May not be enrolled in one of the following Class(es): Junior, Senior

BE 2110 - Statistical Methods for Biomedical Engineering
Topics include descriptive statistics, sampling methods, probability, statistical inference, causality, elementary design of experiments, statistical process improvement methods including Six-Sigma techniques, clinical trial methodology, and variance analysis.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Pre-Requisite(s): MA 1135 or MA 1160 or MA 1161

BE 2400 - Cellular and Molecular Biology
General principles and engineering applications of science and biology, including cell biology, physiology, molecular biology, genetics, and biotechnology.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Class(es): Senior
Pre-Requisite(s): CH 1150 and MA 1160 or MA 1161

BE 2700 - Biomedical Signals & Systems
Introduces the origin, processing and interpretation of biological signals. Mathematical modeling techniques used in the analysis of linear systems. Topics include: Fourier, Laplace and z-transforms, signal comparison techniques, power spectrum analysis, 2-dimensional signals, transfer functions, convolution, and simulations.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Pre-Requisite(s): CH 1150 or CH 1112 and PH 2100 and MA 2160 and ENG 1102

BE 2800 - Biomaterials I: Fundamental Materials Science and Engineering
Introduction to the fundamental materials science principles and different classes of biomaterials (metals, ceramics, polymers and their composites), and some practical professional issues concerning the field of biomaterials.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Pre-Requisite(s): BE 2400

BE 3300 - Biomechanics I: Statics and Dynamics
Course provides overview of two and three-dimensional force and structure systems and their applicability to human body. Course topics will include principle of equilibrium, concept of free-body diagram, moment of inertia, centroids. Kinematics and equations of motion, principle of energy, work and momentum. Course materials tailored for biological applications, particularly for applications at human organ level.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): BE 2400 and (MA 2321 or MA 2320 or MA 2330) and (MA 3521 or MA 3520 or MA 3530) and BL 2010

BE 3350 - Biomechanics II: Soft Tissue and Bio-Fluid Mechanics
This course teaches basic principles of mechanics that are closely related to human soft tissue and bio-flow, particularly, at the human organ level. Emphasize are given to both engineering fundamentals and biomedical applications.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): BE 3300

BE 3400 - Experimental Techniques in Biomedical Engineering
Introduction to the experimental techniques used in biomedical engineering, technical report writing, and record keeping.
Credits: 2.0
Lec-Rec-Lab: (0-1-2)
Semesters Offered: Fall
Pre-Requisite(s): BE 2800

BE 3700 - Biomedical Instrumentation
Introductory theory of measurement and analysis from biological systems. Covers the principles and use of transducers, data recording and analysis systems and signal processing techniques. Example measurements include life science research and clinical measurements such as the vital signs.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): BE 3701

BE 3701 - Biomedical Instrumentation Lab
Laboratory exercises to demonstrate basic instrumentation principles and biomedical measurements. Students will learn how to make non-invasive measurements on themselves and how to evaluate measurement instrumentation. Course will coincide with BE3700 lectures.
Credits: 1.0
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Co-Requisite(s): BE 3700

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BE 3800 - Biomaterials II: Properties and Biological Interactions
Biomaterials properties including structure-function relationships (materials composition and properties), protein/cell materials interactions, characterization methods, and handling and processing considerations.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Pre-Requisite(s): BE 2700(C) and BE 2800

BE 4000 - Independent Study
Students undertake an independent study under the guidance of a Biomedical Engineering faculty member. The course of study may either be research or academic and is decided upon between the study and faculty member.
Credits: variable to 6.0, Repeatable to a Max of 12
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor and department required

BE 4115 - Finite Element Modeling
This course teaches both fundamentals of finite element theory and hands-on experience for bio engineers.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Pre-Requisite(s): (MA 2320 or MA 2321) and (MA 3520 or MA 3521) and (BE 3350 or MEEM 2150)

BE 4200 - Cellular and Molecular Biology II
Covers, at an advanced level, the general principles and engineering applications of science and biology, including cell biology, physiology, molecular biology, genetics, and biotechnology.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2009-2010 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): BE 2400

BE 4220 - Stem Cell Engineering
This course will introduce a historical review of stem cell research and related policies, current stem cell sources and strategies, review of current progress in stem cell research, and application of stem cells in regenerative medicine.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Pre-Requisite(s): BE 2400 and BE 3350 and BE 3800

BE 4250 - Biomedical Optics
Light plays a significant role in modern clinical diagnostics and in the clinical treatment of disease. Examples include non-invasive surgery, optical biopsy, and cancer therapy. This course will focus on the study of how light propagates through biological tissue.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2014-2015 academic year
Pre-Requisite(s): (MA 2320 or MA 2321) and (MA 3520 or MA 3521) and (BE 3350 or MEEM 2150)

BE 4300 - Polymeric Biomaterials
A specialized study of polymers used in biomedical engineering. Topics include: processing-structure-properties relationships for polymers, polymer fibers and composites, degradation of polymers, and medical applications for polymeric biomaterials.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2009-2010 academic year
Pre-Requisite(s): BE 3800

BE 4330 - Biomimetic Materials
This course introduces students to biologically inspired approaches to design functional biomaterials. Topics include the discovery and incorporation of biological designs into novel materials and their application in the biomedical field.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2014-2015 academic year
Pre-Requisite(s): BE 3350 and BE 3800

BE 4335 - Smart Polymers
This course introduces students to smart polymers that change their physical properties in response to various environmental stimuli. Topics include the molecular origin of the stimuli responsiveness of these materials and their applications in the biomedical field.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2015-2016 academic year
Pre-Requisite(s): BE 3350 and BE 3800

BE 4350 - Cell Biomechanics and Mechanical Transduction
This course is designed to introduce the mechanical analysis and characterization of mammalian cells. Mechanotransduction, whereby cells detect loading and respond to the morphology and mechanical properties of the surrounding extracellular matrix, will be emphasized.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Pre-Requisite(s): BE 2400 and BE 3350 and BE 3800

BE 4510 - Cardiovascular Engineering
Fundamental cardiovascular pathology and the biomedical engineering approaches being developed and used toward problems resulting in significant cardiovascular deficiency such as myocardial infarction, chronic kidney disease, atherosclerosis, and heart valve disease.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): BL 2020 and BE 2400

BE 4610 - Biological Microscopy for Engineers
The goal of the course is to inform students of the different imaging techniques available and to help them determine which imaging technique(s) would be most useful for a particular biomedical engineering application.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2014-2015 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): BE 3700

BE 4700 - Biosensors: Fabrication & Applications
This course introduces the student to the fundamentals of biosensor development and applications. It provides an understanding of biological components, immobilization methods, transducers, and fabrication techniques.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2009-2010 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): BE 3600 or (BE 3700 and BE 3701)

BE 4755 - Medical Devices
An introduction to medical devices used for diagnosis, monitoring, and treatment in clinical medicine. Devices will range from those that are noninvasive to those that are surgically implanted such as cardiac pacemakers. Issues regarding safety and government regulations of devices will be included.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Pre-Requisite(s): BL 2020 and BE 3700 and BE 3800 and PH 2200

BE 4770 - Biomedical Microcontrollers
The focus of this course is to provide biomedical engineering students the necessary skills to develop microcontroller-based devices. Provides basic knowledge on computer programming languages, microcontrollers, digital circuits, and microcontroller development kits. Students will design and fabricate a microcontroller-based device using a microcontroller development kit for a specific biomedical application.
Credits: 3.0
Lec-Rec-Lab: (1-0-2)
Semesters Offered: Fall - Offered alternate years beginning with the 2013-2014 academic year
Pre-Requisite(s): BE 3600 or (BE 3700 and BE 3701)

BE 4800 - Biomaterials Interfaces
This course introduces the students to the effects of topography and texture on the performance of biomaterials. Special emphasis is placed on tissue engineering scaffolds and microfabrication and nanofabrication techniques. Some of the topics also include self-organization of biomembranes and supramolecular systems, bioactive materials, and the molecular basis for surface recognition and masking.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2010-2011 academic year
Pre-Requisite(s): BE 3800

BE 4900 - Biomedical Design Fundamentals
Design considerations and professional practice issues are addressed. Ethics, regulatory affairs, and intellectual property are addressed within the context of the biomedical engineering profession. Modern tools of biomedical design are presented and applied to current problems.
Credits: 2.0
Lec-Rec-Lab: (2-0-0)
Semesters Offered: Fall, Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

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BE 4901 - Biomedical Design Project I
Team approach is used to resolve a defined problem in biomedical engineering. Projects are selected and undertaken with faculty guidance and sponsor input. Must be senior project ready, as defined by major, substitutes for prerequisites.
Credits: 2.0
Lec-Rec-Lab: (0-1-3)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Major(s): Biomedical Engineering; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior
Pre-Requisite(s): BE 3500(C) and BE 3600 and (BE 3750 or MEEM 4180) or (BE 3350 and BE 3700 and BE 3701 and BE 3800) and BE 4900

BE 4910 - Biomedical Design Project II
Continuation of Biomedical Design Project I (BE4901) under faculty guidance. Emphasizes design and testing of prototypes. Requires work project notebooks, oral and written reports, and presentations.
Credits: 2.0
Lec-Rec-Lab: (0-1-3)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior
Pre-Requisite(s): BE 4900 and BE 4901

BE 4930 - Biomedical Engineering Topics
Biomedical engineering courses will be offered on new or emerging technical subjects depending on student demand and faculty interest and expertise.
Credits: variable to 6.0; May be repeated
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required

BE 4940 - Introduction to Tissue Engineering
Explores the application of engineering principles toward the construction/reconstruction of human tissue. Fundamental biological principles involved in tissue engineering are reviewed from an engineering perspective with examples of engineered tissues such as blood vessels, skin, liver, cartilage and bone.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2010-2011 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): BE 2400 and BL 2020

Biological Sciences

BL 0600 - Clinical Practicum and Career Preparation Seminar
Presents an overview of hospital-based clinical practicum experiences and pathways to national certification. Also addresses other career options
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Major(s): Biomedical Engineering; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior
Pre-Requisite(s): BE 3500(C) and BE 3600 and (BE 3750 or MEEM 4180) or (BE 3350 and BE 3700 and BE 3701 and BE 3800) and BE 4900

BL 1000 - Introduction to Great Lakes Science
In this introductory science course the Great Lakes are used as the subject to examine environmental issues. A combination of lecture, laboratory, and field experiences will be used to study the uniqueness of the Great Lakes and how they have been impacted by a variety of stressors. Class will have at least one Saturday field trip in September.
Credits: 3.0
Lec-Rec-Lab: (2-0-3)
Semesters Offered: Fall

BL 1010 - General Biology I
A discussion of the principles of ecology and organismal biology, using the theme of physiological ecology and adaptations. This course will emphasize biodiversity, scientific method, experimental design and written and oral presentation of results.
Credits: 4.0
Lec-Rec-Lab: (3-0-3)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Major(s): Medical Laboratory Science, Biological Sciences

BL 1020 - General Biology II
Discussion of the major principles by which life is organized. Topics include scientific methods, biological chemistry, cell structure and organization, multicellular organization, diversity of organisms, energetics and photosynthesis, cellular reproduction genetics, gene structure and expression, and recombinant DNA.
Credits: 4.0
Lec-Rec-Lab: (3-0-3)
Semesters Offered: Spring, Summer
Restrictions: Must be enrolled in one of the following Major(s): Medical Laboratory Science, Biological Sciences
Pre-Requisite(s): BL 1010

BL 1040 - Principles of Biology
Basic principles through which biological systems operate. Topics include cell biology, structure, and function, energy production, genetics, physiology, diversity, evolution, and ecology.
Credits: 4.0
Lec-Rec-Lab: (3-0-2)
Semesters Offered: Fall, Summer
Restrictions: May not be enrolled in one of the following Major(s): Medical Laboratory Science, Biological Sciences

BL 1580 - Introduction to Biological Sciences
Introduction to fields and career opportunities in the biological sciences.
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Major(s): Biological Sciences; Must be enrolled in one of the following Class(es): Freshman, Sophomore

BL 1590 - Introduction to the Health Professions
Introduction to various careers in the health professions. Discusses required course work, entrance exams, and other requirements for entry to the various fields. Guest lecturers include representatives of many health areas.
Credits: 1.0
Lec-Rec-Lab: (1-0-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Class(es): Freshman, Sophomore

BL 1600 - Introduction to Medical Laboratory Science
Introduction to subdisciplines, the clinical practice, career opportunities, and current issues in medical laboratory science.
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall

BL 1710 - Medical Terminology
Autotutorial course covers the fundamentals of medical terminology, including recognition and use of common prefixes, roots, and suffixes, as well as single-syllable words. Exercises also include spelling and pronunciation.
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall

BL 1800 - Biochemistry Orientation
Introduction to current research and career opportunities in biochemistry with emphasis on the interdisciplinary nature of the field.
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall

BL 2010 - Anatomy & Physiology I
Comprehensive introductory course in vertebrate anatomy and physiology with emphasis on the human body. Interrelates structure with function in regard to maintaining homeostasis and normal functioning of the body. Covers the integument, skeletal system, nervous system, muscles, and the endocrine system.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Summer
Pre-Requisite(s): CH 1000 or (CH 1150 and CH 1151)

BL 2011 - Anatomy & Physiology I Lab
The laboratory to accompany BL2010. Examines embryology, muscle and skeletal anatomy, and neuroanatomy. Explores the physiology of the nervous system, including vision and reflexes and muscle physiology. A student-designed lab project is used to teach experimental design.
Credits: 1.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Fall, Summer
Pre-Requisite(s): BL 2010(C)
BL 2020 - Anatomy & Physiology II
Continuation of BL2010. Covers the cardiovascular, respiratory, digestive, renal, and reproductive systems.

Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Pre-Requisite(s): BL 2010

BL 2021 - Anatomy & Physiology II Lab
The laboratory to accompany BL2020. Examines the structure and function of the digestive, respiratory, cardiovascular, and renal systems. A student-designed lab project is used to teach experimental design.

Credits: 1.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Spring
Pre-Requisite(s): BL 2011 and BL 2020(C)

BL 2100 - Principles of Biochemistry
Introductory overview to biochemistry. Topics include the biochemistry of amino acids, proteins, coenzymes, carbohydrates, nucleotides, nucleic acids, lipids, and water, as well as bioenergetics and photosynthesis.

Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Pre-Requisite(s): BL 1020 or BL 1040 or BE 2400 and CH 1112 or (CH 1150 and CH 1151)

BL 2160 - Botany
Covers structure, function, reproduction, and classification of plants and algae, relating these current ecological, agricultural, or other human issues.

Credits: 4.0
Lec-Rec-Lab: (3-0-3)
Semesters Offered: Spring

BL 2170 - Zoology
A discussion of the biology of animals, including the origins and evolution of the metazoan phyla, their physiology, development, ecology, behavior, natural history, and systematics. Emphasizes invertebrates other than insects.

Credits: 4.0
Lec-Rec-Lab: (3-0-3)
Semesters Offered: Fall
Pre-Requisite(s): BL 1010 or BL 1040

BL 2200 - Genetics
A study of classical and molecular genetics. Topics include one- and two-locus genetics, recombination, gene structure, regulation and function, quantitative and population genetics, and genetic engineering. Covers both prokaryotes and eukaryotes.

Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Pre-Requisite(s): BL 1020 or BL 1040 or BE 2400 and CH 1112 or (CH 1150 and CH 1151)

BL 2210 - Genetics Laboratory
A laboratory to complement BL2200. Covers applications of techniques used in genetics, including Mendelian analysis, tetrad analysis, karyotyping, DNA and protein electrophoresis, DNA and plasmid purification, transformation and restriction mapping, and PCR amplification of DNA.

Credits: 1.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Spring, Summer
Pre-Requisite(s): (BL 1020 or BL 1040 or BE 2400) and (BL 2100 or CH 4710)

BL 2210 - Genetic Entomology
A study of the form, function, and diversity of insects along with their relationship to humans as pests and disease vectors and their role in the natural world.

Credits: 4.0
Lec-Rec-Lab: (3-0-3)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): BL 1010 or BL 1040

BL 3012 - Essential Cell Biology
This course will provide an understanding of cell structure and function with emphasis on eukaryotic cells. Topics include macromolecules, membranes, organelles, cytoskeleton, division, differentiation, cell-cell interactions, intracellular trafficking, protein sorting, cell signaling, and motility.

Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Major(s): Biological Sciences, Biochem & Molec Biology-Bio Sc, Bioinformatics; May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): BL 1020 or BL 1040 and BL 2100

BL 3070 - Biology & Occupational Hygiene
The first third of this course will cover fundamentals of cellular and organismal biology. The remainder of the course covers the toxic effects of occupational chemicals, energy forms and industrial pollutants on human tissue. Emphasizes recognition, evaluation, and control of health hazards in the workplace.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Class(es): Freshman

BL 3080 - Biological Concepts for Engineers
An introduction to biological principles centered on human and ecological concepts for engineers and scientists. Course topics include chemistry for biologists, cell structure and function, genetics and heredity, human anatomy and physiology, ecology and the environment, and plant biology and toxicology.

Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Major(s): Environmental Engineering, Civil Engineering

BL 3190 - Evolution
A study of the patterns and processes of organic evolution. Topics include genetics of populations, mechanisms of deterministic and stochastic genetic change, history of life on earth, biogeography, molecular evolution, units of selection, sexual selection, speciation, and human evolution.

Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Pre-Requisite(s): BL 1020 or BL 1040

BL 3210 - General Microbiology
Introduction to the general principles and techniques involved in the study of microorganisms, including bacteria, fungi, and viruses. Topics include cell structure and function, growth, metabolism, biodiversity, and interactions.

Credits: 4.0
Lec-Rec-Lab: (3-0-3)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): (BL 1020 or BL 1040) and (BL 2100 or CH 4710)

BL 3220 - Medical Mycology and Virology
Study of clinically important fungi and viruses.

Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Pre-Requisite(s): BL 1020 or BL 1040

BL 3230 - Medical Microbiology
Study of pathology, identification, isolation and antimicrobial susceptibility testing of clinically important bacteria.

Credits: 4.0
Lec-Rec-Lab: (2-0-5)
Semesters Offered: Spring
Pre-Requisite(s): BL 3210
BL 3300 - Introduction to Genomics
Introduction to Genomics. Genome organization, mapping and characterization from humans and related organisms. Topics include hierarchical arrangement of genes, genome mapping, molecular markers of physical genome maps, genome sequencing, comparative genomics, analysis of important human genes and their products, and ethical and legal aspects of genomics.
Credits: 3
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Summer
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): BL 2200

BL 3310 - Environmental Microbiology
General principles of microbiology, focusing on both the use and control of microorganisms. Topics include microbial structure, function, growth, metabolism, and diversity, as well as microbial involvement in water and waste treatment, waterborne diseases, and pollution control.
Credits: 3
Lec-Rec-Lab: (2-0-3)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Major(s): Medical Laboratory Science, Biochem & Molec Biology-Bio Sc, Bioinformatics, Biological Sciences; May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): BL 1040 or BL 3070 or BL 3080

BL 3400 - Principles of Ecology
Study of both accepted and currently debated principles that describe ecological relationships at the organism, population, community, and ecosystem levels.
Credits: 4
Lec-Rec-Lab: (3-0-3)
Semesters Offered: Fall, Summer
Pre-Requisite(s): BL 1020 or BL 1040

BL 3460 - General Immunology
Investigates the immune defense system that has evolved to protect vertebrates from invading pathogens and cancer. Covers general principles of innate and acquired immunity, immunodeficiency and autoimmune diseases, as well as transplantation immunology, and the role of apoptosis in lymphocyte maturation.
Credits: 3
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Summer
Restrictions: Must be enrolled in one of the following Major(s): Bioinformatics, Medical Laboratory Science, Pharmaceutical Chemistry, Biochem & Molec Biology-Bio Sc, Biomedical Engineering, Biological Sciences; May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): BL 1020 or BL 1040 or BL 2020 or BE 2400

BL 3780 - Medical Parasitology Laboratory
Stresses the visual identification of common human parasites.
Credits: 1
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Major(s): Medical Laboratory Science, Biological Sciences; May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): BL 1710 and BL 2410

BL 3782 - Writing Practicum in Biology
Students will develop and improve their skill level in searching for scientific literature, incorporating that into scientific writing, evaluating and incorporating the work of others, and develop critique skills for review of scientific source material and basic statistical methods.
Credits: 2
Lec-Rec-Lab: (0-2-0)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Major(s): Biological Sciences, Biochem & Molec Biology-Bio Sc, Bioinformatics; May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

BL 3970 - Current Health Issues
Current topics relevant to human health, with emphasis on health maintenance and disease prevention and the role of government in these matters. Topics include: tobacco use and poor diet/physical inactivity, infectious disease, mental and behavioral health, environmental health issues, and health care, including health insurance and models of universal health coverage.
Credits: 3
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring, Summer
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

BL 3990 - Biological Sciences Teaching Experience
Development of teaching skills through assisting in the instruction of a section of biological sciences laboratory. Students gain experience in leadership, group work, organization skills, laboratory preparation, and laboratory instruction.
Credits: variable to 4.0; Repeatable to a Max of 4
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required

BL 4000 - Research in Biology
A literature and laboratory research problem that culminates in a written report on the work performed.
Credits: variable to 9.0; Repeatable to a Max of 9
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required

BL 4001 - Honors Research in Biology
A laboratory-based research problem that culminates in a written report and a seminar presentation on the work performed. Open only to biological sciences and clinical laboratory sciences majors accepted into the Honors in Biological Sciences program.
Credits: variable to 9.0; Repeatable to a Max of 9
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required; Must be enrolled in one of the following Major(s): Biological Sciences, Medical Laboratory Science, Bioinformatics

BL 4010 - Biochemistry I
Structure, biochemical properties, and function of important biomolecules such as proteins and nucleic acids. Introduces enzyme biochemistry (structure, function, catalysis, kinetics, and inhibition).
Credits: 3
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Summer
Pre-Requisite(s): (BL 1020 or BL 1040 or BL 2010) and BL 2100 and (CH 2410 or CH 2420)

BL 4020 - Biochemistry II
Dynamic aspects of living systems. Broad exposure to cellular metabolic pathways, intermediary metabolism and its regulation and bioenergetics.
Credits: 3
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring, Summer
Pre-Requisite(s): BL 4010

BL 4030 - Molecular Biology
Molecular biology of gene structure, expression and regulation. Also topics covering various molecular techniques and applications of these techniques and biotechnology.
Credits: 3
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Summer
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): (BL 1020 or BL 1040) and (BL 2100 or CH 4710)

BL 4033 - Pollination Biology
A study of the coevolutionary relationships of plants and their pollinators. Topics will include floral design and function, floral advertisements and rewards, adaptations of flowers for pollination by animals of different taxa as well as abiotic pollination, floral ecology, and the pollination of crops and the global pollination crisis.
Credits: 3
Lec-Rec-Lab: (1-2-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2012-2013 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): BL 1010 or BL 1040 or BL 2160

BL 4034 - Community Ecology and Evolutionary Dynamics
This is an advanced course that looks at the study of ecology and evolutionary biology at the community level: how populations interact with the abiotic environment and each other to determine patterns of diversity, distribution, and abundance of plants and animals.
Credits: 3
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2014-2015 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): BL 3400 and BL 3190
BL 4035 - Bioimaging
Current concepts in light and electron microscopy and scanning probe techniques. Theory and practice of fluorescence (including confocal and multiphoton), atomic force, scanning and transmission electron, and video microscopy as applied to biological specimens with emphasis on sample preparation. Half semester course.
Credits: 2.0
Lec-Rec-Lab: (0-4-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2010-2011 academic year
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior

BL 4036 - Ecology and Evolution of Interactions Between Plants and Insects
Plants and insects have played major roles in influencing each others evolutionary diversification. We will examine the ecology and evolution of plant-insect interactions in basic and applied contexts. A solid foundation of tools in ecology and evolution will be established and class will include lectures and interactive discussions from readings of the primary literature.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2013-2014 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): BL 3400 and BL 3190

BL 4042 - Scanning Electron Microscopy of Biological Specimens
Hands-on training in operation of the scanning electron microscope (SEM). Students prepare biological specimens of their choice for observation. Successful completion of course is prerequisite to becoming a certified SEM operator in the ACMAL. Half semester course.
Credits: 2.0
Lec-Rec-Lab: (0-2-6)
Semesters Offered: Fall - Offered alternate years beginning with the 2010-2011 academic year
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior
Co-Requisite(s): BL 4035

BL 4052 - Fluorescence and Video Microscopy of Biological Specimens
Hands-on training in fluorescence microscopy and video microscopy. Students prepare biological specimens of their choice for observation. Half semester course.
Credits: 2.0
Lec-Rec-Lab: (0-2-6)
Semesters Offered: Fall - Offered alternate years beginning with the 2010-2011 academic year
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): BL 4035

BL 4062 - Transmission Electron Microscopy of Biological Specimens
Hands-on training in operation of the transmission electron microscope (TEM). Students prepare biological specimens of their choice for observation. Successful completion of course is prerequisite to becoming a certified TEM operator in ACMAL. Half semester course.
Credits: 2.0
Lec-Rec-Lab: (0-2-6)
Semesters Offered: Spring - Offered alternate years beginning with the 2010-2011 academic year
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): BL 4035

BL 4090 - Tropical Island Biology
A survey of island biology, including marine and terrestrial habitats. Topics include formation of carbonate islands, geological history of the Bahamas, island plant communities, intertidal, grass bed, mangrove and coral reef communities. Special course fees. Consult department before enrolling. Completion of BL1020 or BL1040 desirable but not necessary.
Credits: 2.0
Lec-Rec-Lab: (0-2-0)
Semesters Offered: Spring
Pre-Requisite(s): BL 4035

BL 4100 - Special Topics in Biological Sciences
A study of recent developments in the biological sciences.
Credits: variable to 10.0. Repeatable to a Max of 10
Semesters Offered: Fall, Spring, Summer

BL 4120 - Environmental Remediation and Toxicology
Toxicology of major environmental pollutants, their dose-response relationships and fundamentals of environmental remediation. Topics include physical, chemical, and biological remediation methods and effect of environmental toxins on biological systems. Laboratory will involve the application of chemical and biological remediation techniques.
Credits: 3.0
Lec-Rec-Lab: (2-0-2)
Semesters Offered: Fall - Offered alternate years beginning with the 2011-2012 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): BL 1020 or BL 1040

BL 4134 - Field Methods in Great Lakes Oceanography
Field intensive course held at the University of Michigan Biological Station. Significant time will be spent on a research vessel (R/V Laurentian) where students will use a variety of traditional and state-of-the-art techniques to characterize biological communities and measure important physical and biological processes.
Credits: 2.0
Lec-Rec-Lab: (1-0-3)
Semesters Offered: Summer
Restrictions: Permission of instructor required

BL 4140 - Plant Physiology
Physiology and biochemistry of plants. Emphasizes photosynthesis, plant hormones, water and nutrient relations, and light-regulated development.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2005-2006 academic year
Pre-Requisite(s): BL 2160 and CH 2420

BL 4145 - Plant-Microbe Interactions
Interactions between plants and microorganisms in the environment. Topics include microbial virulence, signaling, gene expression, beneficial interactions and disease resistance in plants. Laboratory will focus on plant biochemical and microbiological methods as they relate to environmental problems.
Credits: 3.0
Lec-Rec-Lab: (2-0-2)
Semesters Offered: Fall - Offered alternate years beginning with the 2012-2013 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): BL 2200

BL 4150 - Field Methods in Great Lakes Oceanography
Field intensive course held at the University of Michigan Biological Station. Significant time will be spent on a research vessel (R/V Laurentian) where students will use a variety of traditional and state-of-the-art techniques to characterize biological communities and measure important physical and biological processes.
Credits: 2.0
Lec-Rec-Lab: (1-0-3)
Semesters Offered: Summer
Restrictions: Permission of instructor required

BL 4160 - Field Methods in Great Lakes Oceanography
Field intensive course held at the University of Michigan Biological Station. Significant time will be spent on a research vessel (R/V Laurentian) where students will use a variety of traditional and state-of-the-art techniques to characterize biological communities and measure important physical and biological processes.
Credits: 2.0
Lec-Rec-Lab: (1-0-3)
Semesters Offered: Summer
Restrictions: Permission of instructor required

BL 4440 - Fish Biology
Fishes and their habitat, native and exotic fishes of the Great Lakes region, and ocean fishery resources will be examined. Basic topics in ichthyology and fish ecology, evolution, genetics, reproduction strategies and identification of early life stages, fish community structure, food webs and dynamics. Laboratory exercises on sampling, identification and classification of fishes and basic fish anatomy and discussion of scientific papers relevant to the subject material.
Credits: 4.0
Lec-Rec-Lab: (3-0-3)
Semesters Offered: Spring - Offered alternate years beginning with the 2006-2007 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): BL 1020 or BL 1040
BL 4442 - Lake Ecology and Fish Biology
Field course combining lake ecosystem and foodweb study with fishes in lake systems. Students will be exposed to research methods used in lakes for comprehensive abiotic and biotic understanding.
Credits: 4.0
Lec-Rec-Lab: (3-0-3)
Semesters Offered: Fall - Offered alternate years beginning with the 2014-2015 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): BL 1010 or BL 1040 or BL 3400

BL 4447 - Stream Ecology and Fish Biology
Field course combining river and stream ecosystem and foodweb study with fishes in lake systems. Students will be exposed to research methods used in lakes for comprehensive abiotic and biotic understanding.
Credits: 4.0
Lec-Rec-Lab: (3-0-3)
Semesters Offered: Fall - Offered alternate years beginning with the 2015-2016 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): BL 1010 or BL 1040 or BL 3400

BL 4450 - Limnology
The study of biological, physical, and chemical processes of freshwater systems using a watershed perspective. Movement of nutrients/organisms from land, via streams/tributaries, into lakes will be studied, with emphasis on field work in local lakes/streams.
Credits: 2.0
Lec-Rec-Lab: (0-2-4)
Semesters Offered: Fall - Offered alternate years beginning with the 2011-2012 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): CH 1122 or (CH 1160 and CH 1161)

BL 4455 - Research Methods in Aquatic Ecology
This field and laboratory based course is designed for advanced undergraduate students. Guided by ecological, physiological, and evolutionary theory, we will explore and quantitatively sample flora and fauna, ecosystem processes, and habitat in streams and lakes using traditional and current techniques.
Credits: 2.0
Lec-Rec-Lab: (0-2-4)
Semesters Offered: Fall - Offered alternate years beginning with the 2011-2012 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): BL 4450 and (BL 4450 or FW 4220 or ENVE 4505)

BL 4461 - Ecosystem Ecology
Study of processes in aquatic and terrestrial ecosystems, including energy flow, ecosystem production, and nutrient cycling. We will explore these processes through a historical overview of influential research programs and regional to global case studies.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2011-2012 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): BL 3400 and CH 1122 or (CH 1160 and CH 1161)

BL 4465 - Biological Oceanography
An overview of ocean environments and marine life. Topics include: trophic level interactions, nutrient cycling, ecology of plankton, invertebrates, fish, mammal and bird resources, and human influences on marine ecosystems. Will cover basic water chemistry and light in oceans.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): BL 1010 or BL 1040 or BL 3070

BL 4510 - Senior Capstone Experience
Reading, interpreting, and integrating information from the primary literature of biological sciences. Emphasizes oral and written presentation skills.
Credits: 2.0
Lec-Rec-Lab: (0-2-0)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Major(s): Biological Sciences, Biochem & Molec Biology-Bio Sc, Bioinformatics; May not be enrolled in one of the following Class(es): Senior
Pre-Requisite(s): BL 4000(C) or BL 4001(C) or BL 4995(C)

BL 4550 - Clinical Chemistry
A study of clinical biochemistry of the human body. Theory and practical applications used in routine analysis of body fluids. Includes the study of electrolyte balance, acid base balance, and the functions of major organs and systems.
Credits: 3.0
Lec-Rec-Lab: (2-0-3)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Major(s): Clinical Laboratory Science, Medical Laboratory Science, Biological Sciences; May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): BL 2020 and BL 3640

BL 4610 - Medical Laboratory Science Medical Practicum I
Practical and didactic training in clinical chemistry, immunopathology, and medical microbiology under the direction of National Accrediting Agency for the Clinical Laboratory Sciences (NAACLS)-approved/accredited hospital internship program personnel.
Credits: 15.0
Lec-Rec-Lab: (15-0-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Major(s): Medical Laboratory Science

BL 4611 - Medical Laboratory Science Medical Practicum II
Practical and didactic training in hematology, urinalysis, and immunohematology under the direction of National Accrediting Agency for the Clinical Laboratory Sciences (NAACLS)-approved/accredited hospital internship program personnel.
Credits: 15.0
Lec-Rec-Lab: (15-0-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Major(s): Medical Laboratory Science

BL 4720 - Hematology and Hemostasis
Recent developments in Clinical Laboratory Science. Integrates basic and clinical immunological principles as well as outlines the diagnosis and evaluation of immune disorders and selected infectious diseases.
Credits: 2.0
Lec-Rec-Lab: (2-0-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Major(s): Medical Laboratory Science, Biological Sciences; May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): BL 2410 and BL 3640

BL 4640 - Clinical Immunology & Serology
Integrates basic and clinical immunological principles as well as outlines the diagnosis and evaluation of immune disorders and selected infectious diseases.
Credits: 2.0
Lec-Rec-Lab: (2-0-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Major(s): Medical Laboratory Science, Biological Sciences; May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): BL 2410 and BL 3640

BL 4660 - Current Topics in Medical Laboratory Science
Recent developments in Clinical Laboratory Science.
Credits: variable to 4.0; Repeatable to a Max of 6
Semesters Offered: Fall, Spring
Restrictions: Permission of instructor required
BUS 1100 - Introduction to Business
Introduction to planning, organizing, decision-making, leadership and control in a business. Business disciplines of accounting, finance, information systems, management, marketing, and operations are introduced, along with discussions of business ethics and social responsibility.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring, Summer

BUS 2100 - Business Statistics
Introduction to basic concepts and methods of probability and statistics, including the following topics: collection, description and presentation of data, probability, random variables, sampling, probability distributions, estimation and hypothesis testing, ANOVA, and selected non-parametric techniques.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): MA 1135 or MA 1160 or MA 1161

BUS 2200 - Business Law
Provides an understanding of the legal basis of contracts and their enforcement in the areas of general contracts, contracts of commercial sales and of agency, and commercial paper.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring, Summer

BUS 2300 - Quantitative Problem Solving
Stresses development of quantitative decision and analysis skills to solve problems with cases, exercises, simulations, and mathematical modeling. Topics include regression analysis, decision analysis, stochastic environments, data sources and errors, utility theory risk preference, linear programming, and simulation analysis.
Credits: 3.0
Lec-Rec-Lab: (3-0-3)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): BUS 2100 or MA 2710 or MA 2720 or MA 3710 or MA 3720

BUS 3900 - Business Internship
A practical approach to business problem solving. Requires a report on work activity upon completion of the internship.
Credits: variable to 4.0; Repeatable to a Max of 4
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required; Must be enrolled in one of the following College(s): School of Business & Economics

BUS 4900 - Research Projects
Under the general guidance of a faculty member, students read, conduct research, and prepare reports and papers as required. The SBE's Curriculum Committee must approve the subject of the proposed project.
Credits: variable to 4.0; Repeatable to a Max of 6
Semesters Offered: On Demand
Restrictions: Permission of instructor and department required; May not be enrolled in one of the following Class(es): Freshman, Sophomore

BUS 4910 - Global Business Experience International Residency
This course prepares students for an international business residency overseas and provides a structure for debriefing their international residency experience.
Credits: 3.0
Lec-Rec-Lab: (1-0-6)
Semesters Offered: Summer
Restrictions: Permission of department required; Must be enrolled in one of the following Class(es): Freshman, Sophomore

BUS 4990 - Special Topics in Business
Business topics of interest to students and faculty.
Credits: variable to 3.0; Repeatable to a Max of 6
Semesters Offered: On Demand
Restrictions: Permission of instructor required; May not be enrolled in one of the following Class(es): Freshman, Sophomore

BUS 4991 - Business Development Experience I
Provides students with hands-on entrepreneurial learning experience by placing them in close proximity of real world entrepreneurs and innovators. Students ascertain commercial viabilities of intellectual property, senior design or enterprise projects, independent new ventures or early stage business incubators.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Class(es): Senior
Pre-Requisite(s): BUS 1100 and BUS 2300 and ACC 2000 and ACC 2100 and BUS 2200 and MGT 2000 and MIS 2000 and FIN 3000 and OMS 3000 and MGT 3000 or MKT 3000
Civil Engineering

CE 1000 - Civil Engineering
An introduction to the civil engineering profession with emphasis on careers open to the civil engineering students. Topics include: scope, specialties, education, professional practice, lifelong learning, contemporary issues, ethics and societal impacts related to civil engineering.
Credits: 1.0
Lec-Rec-Lab: (1-0-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Class(es): Senior
Pre-Requisite(s): BUS 4991

CE 1001 - Sustainability and Civil Engineering Practice
Course will focus on characterizing the motivation for and principles of sustainable engineering and provide an introduction to tools used in sustainable design. Course topics follow a logical and linear progression which includes the societal context, scientific motivation, and application of sustainable practices in civil engineering.
Credits: 1.0
Lec-Rec-Lab: (1-0-0)
Semesters Offered: Spring

CE 3101 - Civil Engineering Materials
Covers properties and behavior of typical civil engineering materials, including wood, metals, aggregates, asphalt cement concrete, portland cement concrete, and composites. Laboratory exercises demonstrate selected engineering mechanics principles, including elastic, inelastic, and time-dependent material behavior. Additional topics include testing techniques, materials standards, report writing, and presentation of experimental data.
Credits: 3.0
Lec-Rec-Lab: (0-2-3)
Semesters Offered: Fall, Spring
Pre-Requisite(s): ENG 2120 or MEEM 2150

CE 3202 - Structural Analysis
Introduction to structural concepts and techniques for analyzing trusses, determinate and indeterminate beams, and frame structures. Apply concepts from statics and mechanics of materials to determine internal forces and deflections of structural members and systems, including loads and load paths.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): ENG 2120 or MEEM 2150 and (MA 2320 or MA 2321 or MA 2330)

CE 3331 - Professional Practice
Professional expectations of civil and environmental engineers demonstrated through readings, discussion, and writing. Topics include the consequences of engineering, design issues, legal aspects, ethical considerations, government requirements, management, leadership, and contract issues.
Credits: 2.0
Lec-Rec-Lab: (2-0-0)
Semesters Offered: Fall, Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

CE 3332 - Fundamentals of Construction Engineering
Introduction to concepts required by professionals involved in the construction industry. Includes contracts, bidding, estimating, scheduling, cash flow, safety, labor issues, equipment ownership, and productivity.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

CE 3401 - Transportation Engineering
Introduction to transportation in the United States, transportation modes, characteristics and applications, highway geometrics and design standards, pavement design and management.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman

CE 3560 - Hydraulics and Hydrology
Course is intended for graduate students who need additional coursework in this subject matter. Topics covered include pipe flow, distribution networks, culverts, rivers and channels, hydrologic cycle, flooding, precipitation, infiltration, evaporation, and runoff. Same material as CE3620, but without the lab.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring
Restrictions: Permission of Instructor required; Must be enrolled in one of the following Level(s): Graduate

CE 3710 - Uncertainty Analysis in Engineering
Introduction to probability, statistics, and uncertainty analysis with examples from civil engineering (e.g., models of vehicle arrivals, structural reliability, flood distributions). Topics include: discrete probability theory, probability distributions, parameter estimation, confidence intervals, hypothesis tests, linear regression, and model selection.
Credits: 4.0
Lec-Rec-Lab: (3-0-3)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): GE 2000 and (MEEM 2150 or ENG 2120) and ENG 3200

CE 3810 - Soil Mechanics for Engineers
Develops the terminology and descriptions common to the field. Studies soil compressibility, fluid flow, response to mechanical compaction, and strength as well as methods of determining geostatic stresses and stress changes due to boundary loadings. An experimental laboratory experience reinforces the lecture material.
Credits: 3.0
Lec-Rec-Lab: (3-0-3)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): GE 2000 and (MEEM 2150 or ENG 2120) and ENG 3200

CE 4010 - Introduction to Consulting Engineering
Covers the role of consultants, organizational structure, accounting, getting work and dealing with clients, preparing proposals, presentations, estimating costs, project management, liability, and professional ethics.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

CE 4020 - Computer Applications: Visualizing and Communicating
Design information
Problem-solving using industry standard software, such as Civil3D, is applied to civil and environmental engineering projects such as terrain modeling, earthwork calculations, and pavement alignment. Concepts involving data management, data visualization, and risk analysis are introduced.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior
Pre-Requisite(s): CE 3332 or CE 3401(C)

CE 4101 - Bituminous Materials
Applications and properties of asphalt binder, aggregates for bituminous mixtures, and analysis and design of asphalt concrete mixtures. Includes asphalt cement production, rheology, chemistry, and grading, aggregate grading and blending, and mixture design and characterization. Also discusses asphalt mixture production, construction, and recycling.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Fall, Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior
Pre-Requisite(s): CE 3101

CE 4201 - Matrix Structural Analysis
Analysis of trusses and frames by the direct stiffness method. Use of a typical commercial computer code is stressed as a tool for complex structures. Introduces three-dimensional structures.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Spring
Pre-Requisite(s): CE 3202
CE 4213 - Structural Concrete Design
Introduction to design of reinforced concrete structural components. Analyze and design reinforced concrete beams, columns, and footings. Understand material behavior, limit state criteria, and practical detailing considerations. Application of the ACI 318 to cast-in-place and precast systems.
Credits: 4.0
Lec-Rec-Lab: (0-3-2)
Semesters Offered: Spring
Pre-Requisite(s): CE 3202

CE 4223 - Steel Design I
Behavior and design of structural steel members using both ASD and LRFD approaches. Covers material behavior, external loads, and the design of tension, compression, and flexural members (rolled, built-up, and composite), and simple welded and bolted connections.
Credits: 4.0
Lec-Rec-Lab: (0-3-2)
Semesters Offered: Fall, Summer
Pre-Requisite(s): CE 3202

CE 4233 - Structural Timber Design
Introduction to the use of wood as a structural engineering material. Includes design of beams, columns, nailed and bolted connection, glulam members, including tapered beams, tapered and curved beam, and design of wood shear walls and diaphragms.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): CE 3202

CE 4333 - Estimating and Planning of Construction Projects
Examination of the principles and techniques of estimating construction costs leading to the development of an estimate and proposal submission. The relationship between the contract specification, drawings, and the estimate will be illustrated.
Credits: 3.0
Lec-Rec-Lab: (2-0-2)
Semesters Offered: Fall
Pre-Requisite(s): CE 3332

CE 4344 - Construction Scheduling
This course will introduce students to the basics of construction scheduling. Topics covered will include: Fundamentals of different scheduling methods such as Critical Path Method and linear scheduling, Resource allocation in schedules, and Schedule monitoring and control methods.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): CE 3332 or CMG 3265

CE 4401 - Pavement Design
Analysis, behavior, performance, and structural design of highway pavements. Introduces pavement types and performance concepts, highway traffic and subgrade characterization, materials employed in highway construction, and highway drainage. Presents common methods used for designing pavement structures as well as mechanistic-empirical approaches.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): CE 3401 and CE 3101

CE 4402 - Traffic Engineering
Introduction to traffic engineering, traffic characteristics, data collection techniques, capacity analysis, traffic control devices, intersection control, traffic signal systems, parking, and street operations.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): CE 3401 and CE 3101

CE 4404 - Railroad Engineering
Overview of basic elements and roles of rail transportation, history, organizations and economics, safety, intercity and urban passenger rail, freight operations, track-train dynamics, signals and communications, motive power and equipment, track components, construction and maintenance.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Pre-Requisite(s): CE 3401 and CE 3101

CE 4406 - Airport Planning and Design
Introduction to the air transportation system, airport planning studies, demand forecasting, aircraft characteristics, runway requirements, airport layout and design. Also includes environmental impacts, airport capacity and operations, terminal and ground access planning and analysis.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring

CE 4407 - Transportation Design
An introduction to the planning-design-construction process for highways, intersections, and railroads. Operations, capacity, safety, and geometric design features. Horizontal and vertical alignment and cross sections. Design criteria, standards, environmental aspects, cost, and construction considerations. Use of CAD systems in preparing contact plans.
Credits: 3.0
Lec-Rec-Lab: (2-0-2)
Semesters Offered: Spring
Pre-Requisite(s): CE 3401

CE 4410 - Transportation Planning
An introduction to urban transportation planning, planning data collection, transportation planning models, and development and evaluation of transportation plans. Includes extensive use of transportation planning software to evaluate transportation plans in multimodal networks.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Pre-Requisite(s): CE 3401
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

CE 4490 - Rail Transportation Seminar
Presentations and discussion of current literature and research related to rail transportation.
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Spring
Pre-Requisite(s): CE 3401
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

CE 4510 - Baccalaureate Thesis
Independent baccalaureate research project performed under the supervision of one or more faculty.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): CE 3401

CE 4620 - River and Floodplain Hydraulics
Analysis of open channel systems, including natural channels, designed channels, flow transitions, non-uniform flow, and unsteady flow.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Pre-Requisite(s): CE 3401

CE 4640 - Stormwater Management and Low Impact Development
Management systems and newer approaches based on the philosophy of low impact development (LID) that seek not to alter the natural ecology of a site.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring, Summer
Pre-Requisite(s): CE 3401

CE 4665 - Stream Restoration
Basic mechanics of the transport of sediments in natural systems, including tractive forces and geomorphic functions.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Pre-Requisite(s): CE 3401

CE 4750 - Risk Analysis and Management
Fundamentals methods in analyzing and mitigating risks involved in services that function at the interface of human, natural and engineered systems. Relevant systems include transportation, service, utility, emergency and hazard management, and project management.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): CE 3710 or MA 3710

CE 4760 - Optimization Methods in Design and Decision Making
Decision analysis and optimization techniques, including linear programming, nonlinear programming, and dynamic programming. Computer-based solutions of design problems in various engineering specialty areas are considered.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Pre-Requisite(s): CE 3710 or MA 3710

CE 4760 - Optimization Methods in Design and Decision Making
Decision analysis and optimization techniques, including linear programming, nonlinear programming, and dynamic programming. Computer-based solutions of design problems in various engineering specialty areas are considered.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Pre-Requisite(s): CE 3710 or MA 3710

CE 4800 - Projects in Transportation
Team-based, project-oriented planning and design experience in transportation systems and facilities. Focus on transportation planning, system analysis, network optimization, transportation operations, and expanded emphasis on environmental, safety, and economic impacts.
Credits: 3.0
Lec-Rec-Lab: (2-0-2)
Semesters Offered: Fall, Spring
Pre-Requisite(s): CE 3401
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

CE 4801 - Thesis Seminar
A seminar for candidates working on their Baccalaureate Thesis. Open only to candidates and their advisor.
Credits: 1.0
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Class(es): Freshman, Sophomore

CE 4810 - Transportation Project Seminar
The project selected in CE 4800 and continued in this seminar. Open only to candidates and their advisor.
Credits: 1.0
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Class(es): Freshman, Sophomore

CE 4820 - Independent Study
Individual study program under the supervision of one or more faculty. A maximum of 6 credits is allowed in any degree program. The Work is to be conducted in the laboratory, field, or in an industrial setting.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): CE 3401
Restrictions: Must be enrolled in one of the following Class(es): Freshman, Sophomore

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CE 4820 - Foundation Engineering
Applies the fundamentals learned in CE3810 to problems in geotechnical engineering. Learn the procedures used to design footings, piled foundations, retaining walls, marine structures, and slopes. Computational laboratory reinforces lectures; students have direct access to the instructor as the design is being developed.
Credits: 3.0
Lec-Rec-Lab: (2-0-2)
Semesters Offered: Fall
Pre-Requisite(s): CE 3810

CE 4830 - Geosynthetics Engineering
Geosynthetic materials are grouped by mechanical characteristics and engineering use. They are widely used in highway, landfill, and embankment design. Develop designs for filters, soil separators, reinforced earth, and impermeable membranes. Also learn when using a geotextile is appropriate.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Pre-Requisite(s): CE 3810

CE 4850 - Rock Engineering for Civil Engineers
This course focuses on the applied behavior of rock encountered primarily in civil engineering projects. Topics include rock classification, rock durability, rock mass strength classification, use of stereo nets, rock reinforcement, blasting, rock socket application and bearing capacity on rock.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2009-2010 academic year
Pre-Requisite(s): CE 3810

CE 4900 - Engineering Design Project I
An engineering design project related to civil and environmental engineering. Not available to students who have taken CE4905. Students must complete both CE4900 and CE4910 to fulfill senior design requirements. Must be senior project ready as defined by major department.
Credits: 3.0
Lec-Rec-Lab: (0-2-3)
Semesters Offered: Fall, Summer
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

CE 4905 - Engineering Design Project
An engineering design project related to civil and environmental engineering. Not available to students who have taken CE4900 or CE4910. (Senior project ready as defined by major substitutes for prerequisites)
Credits: 3.0
Lec-Rec-Lab: (0-2-3)
Semesters Offered: Fall, Spring, Summer
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

CE 4910 - Engineering Design Project II
Continuation of CE4900. Not available to students who have taken CE4905. Students must complete both CE4900 and CE4910 to fulfill senior design requirements. Senior project ready as defined by major substitutes for prerequisites.
Credits: 3.0
Lec-Rec-Lab: (0-2-3)
Semesters Offered: Spring, Summer
Pre-Requisite(s): CE 4900

CE 4915 - International Engineering Field Experience
An engineering design project that incorporates an international experience. Must be taken in conjunction with CE4916 in order to fulfill senior design requirements. Must be senior project ready as defined by major department.
Credits: 3.0
Lec-Rec-Lab: (0-2-3)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Class(es): Senior

CE 4916 - International Senior Design Field Project
An engineering design project that incorporates an international experience. Must be taken in conjunction with CE4915 in order to fulfill senior design requirements. Senior project ready as defined by major substitutes for prerequisites.
Credits: 3.0
Lec-Rec-Lab: (0-2-3)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Class(es): Senior
Pre-Requisite(s): CE 4915

CE 4920 - Civil Engineering Independent Study
Approved research or design project in civil engineering, originating with an individual student or assigned by the instructor.
Credits: variable to 3.0; Repeatable to a Max of 3
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required; May not be enrolled in one of the following Class(es): Freshman, Sophomore

CE 4990 - Special Topics in Civil Engineering
Topics of special interest in civil or environmental engineering.
Credits: variable to 3.0; Repeatable to a Max of 9
Semesters Offered: Fall, Spring, Summer

Chemistry

CH 0100 - Chemistry Coaching
Scheduled weekly individual or study group session with an experienced chemistry coach to improve mastery of chemistry material, problem-solving skills, and awareness of expectations in first year chemistry.
Credits: 0.0; May be repeated
Semesters Offered: Fall, Spring

CH 0200 - Organic Chemistry Coaching
Scheduled weekly individual or study group session with an experienced organic chemistry coach to improve understanding of organic structures, develop skills for predicting products of organic reactions, the drawing of mechanisms and determining synthesis strategies as well as awareness of expectations in a specific discipline of chemistry.
Credits: 0.0; May be repeated
Semesters Offered: Fall, Spring

CH 1000 - Preparatory Chemistry
Fundamental principles, laws, and theories of chemistry for students who have not taken high school chemistry, but who have one unit of high school algebra or equivalent.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Summer

CH 1112 - University Chemistry - Studio Laboratory I
Introduces experimental and theoretical chemical concepts from a hands-on, inquiry-based perspective. Emphasis is placed on experimental methods, reactions and stoichiometry, states of matter, thermochemistry, periodicity and bonding, solutions, and kinetics.
Credits: 5.0
Lec-Rec-Lab: (3-1-3)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Major(s): Biochem & Molec Biology-Chem, Pharmaceutical Chemistry, Chemistry, Cheminformatics
Pre-Requisite(s): MA 1031 or MA 1032

CH 1112 - University Chemistry - Studio Laboratory II
Introduces more complex experimental and theoretical concepts from a hands-on, inquiry-based perspective. Emphasis is on experimental methods, kinetics, equilibria, thermodynamics, electrochemistry, and special topics which may include chemical analysis, organic synthesis, computational methods, and biochemistry.
Credits: 5.0
Lec-Rec-Lab: (3-1-3)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Major(s): Biochem & Molec Biology-Chem, Pharmaceutical Chemistry, Chemistry, Cheminformatics
Pre-Requisite(s): CH 1112 or (CH 1150 and CH 1151)

CH 1130 - Professional Development for Chemists I: Orientation
Required for all entering chemistry majors. Intro to department, cover writing, technical software, library resources, reading and writing reports, academic integrity, career services, and other orientation topics. First course in a four-part professional development sequence.
Credits: 1.0
Lec-Rec-Lab: (1-0-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Major(s): Biochem & Molec Biology-Chem, Pharmaceutical Chemistry, Chemistry, Cheminformatics

CH 1150 - University Chemistry I
Introduces the foundations of chemistry, including electronic structure of atoms and molecules, intermolecular forces, states of matter, chemical reactions, organic chemistry, chemical equilibria, kinetics, and acid-base chemistry. Includes laboratory component that emphasizes lecture components.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring, Summer
Co-Requisite(s): CH 1151
Pre-Requisite(s): MA 1031(C) or MA 1032(C) or MA 1160(C) or MA 1161(C) or MA 1135(C) or ALEKS Math Placement >= 56 or CEEB Calculus AB >= 2 or CEEB Calculus BC >= 2 or CEEB Calculus AB Subscore >= 2
CH 1151 - University Chemistry Lab I
Laboratory to accompany CH1150.
Credits: 1.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): CH 1150
CH 1160 - University Chemistry II
A continuation of CH 1150. Introduces more complex concepts in chemistry, related to career planning, such as resume writing, interviewing, selecting scholarships and grants, and oral communication skills.
Credits: 2.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): MA 1031(C) or MA 1032(C) or MA 1160(C) or MA 1161(C) or MA 1135(C) or ALEKS Math Placement >= 56 or CEEB Calculus AB >= 2 or CEEB Calculus BC >= 2 or CEEB Calculus AB Subscore >= 2
CH 1153 - University Chemistry Recitation I
Problem solving session to support University Chemistry I - CH1150.
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): CH 1150
CH 1160 - University Chemistry II
A continuation of CH 1150. Introduces more complex concepts in chemistry, including kinetics, chemical equilibria, acid-base equilibria, thermodynamics, electrochemistry, and chemical analysis. Additional topics may include chemistry of the metals and non-metals, biochemical systems, and nuclear chemistry. Includes laboratory component that emphasizes lecture concepts.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): CH 1150 or (CH 1150 and CH 1151)
CH 1161 - University Chemistry Laboratory II
Laboratory to accompany CH1160.
Credits: 1.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): CH 1161 or (CH 1150 and CH 1151)
CH 1163 - Problem Solving in University Chemistry II - CH1160
Problem solving session to support University Chemistry II - CH1160.
Credits: 2.0
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): CH 1160 or (CH 1150 and CH 1151)
CH 2130 - Professional Development for Chemists 2: Career Planning
Continuation from CH2130 and provides a more in-depth review of topics related to refining written and oral communication skills, including advanced library resources, reading and writing reports, and seminar attendance.
Credits: 3.0
Lec-Rec-Lab: (3-0-3)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): CH 1122 or (CH 1160 and CH 1161) and MA 2160 and PH 2200(C)
CH 2212 - Quantitative Analysis
Measurements and calculations relevant to volumetric and gravimetric analysis as well as electrochemistry and separations. Error analysis and statistical treatment of data. In the laboratory, introduces classical and contemporary techniques that require high quality measurements.
Credits: 5.0
Lec-Rec-Lab: (3-0-6)
Semesters Offered: Spring
Pre-Requisite(s): CH 1122 or (CH 1160 and CH 1161)
CH 2410 - Organic Chemistry I
A study of the chemistry of carbon compounds. Review of hybrid orbitals, covalent bonding, and resonance. Introduction to nomenclature, stereochemistry, infrared and nuclear magnetic resonance spectroscopy, functional group chemistry based on reaction mechanisms, and multi-step synthesis.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): CH 1122 or (CH 1160 and CH 1161)
CH 2411 - Organic Chemistry Lab I
Laboratory to accompany CH2410.
Credits: 1.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): CH 2410(C) and CH 1122 or (CH 1160 and CH 1161)
CH 2420 - Organic Chemistry II
Continuation of CH2410. Covers more functional group chemistry based on reaction mechanisms; more involved multi-step synthesis; introduction to carbohydrates, amino acids, proteins, nucleic acids; and topics of specialized interest.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring, Summer
Pre-Requisite(s): CH 2410
CH 2421 - Organic Chemistry Lab II
Laboratory to accompany CH2420.
Credits: 2.0
Lec-Rec-Lab: (0-0-4)
Semesters Offered: Spring, Summer
Pre-Requisite(s): CH 2411 and CH 2420(C)
CH 3130 - Professional Development for Chemists 3: Communication
Continuation from CH3130 and provides a more in-depth review of topics related to refining written and oral communication skills, including advanced library resources, reading and writing reports, and seminar attendance.
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Major(s): Biochem & Molec Biology-Chem, Pharmaceutical Chemistry, Chemistry, Cheminformatics
Pre-Requisite(s): CH 2130
CH 3510 - Physical Chemistry I - Thermodynamics, Equilibrium and Kinetics
Ideal and non-ideal gas laws, the kinetic theory of gases, equations of state, liquid-vapor equilibrium, the laws of thermodynamics, solid-liquid-vapor equilibria, the chemical potential, chemical equilibrium, electrochemistry, the phase rule, phase diagrams, and chemical kinetics.
Credits: 3.0
Lec-Rec-Lab: (3-0-3)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): CH 1122 or (CH 1160 and CH 1161) and MA 2160 and PH 2200(C)
CH 3511 - Physical Chemistry Lab I
Laboratory to supplement CH3510.
Credits: 2.0
Lec-Rec-Lab: (0-0-4)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): CH 3510(C)
CH 3520 - Physical Chemistry II - Molecular Structure
Continuation of CH3510. Covers solid-state chemistry, surface chemistry, atomic and molecular spectroscopy and structure, chemical applications of group theory, valence, the periodic table, elements of quantum mechanics, and statistical thermodynamics.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Pre-Requisite(s): CH 1122 or (CH 1160 and CH 1161) and MA 3160 and PH 2200(C)
CH 3521 - Physical Chemistry Lab II
Laboratory to supplement CH3520.
Credits: 2.0
Lec-Rec-Lab: (0-0-4)
Semesters Offered: Spring
Pre-Requisite(s): CH 3520(C)
CH 3540 - Biophysical Chemistry
Examines fundamental physical principles underlying complex biological systems in order to understand the interactions and behaviors found in biological, biochemical, and physical systems. Topics include macromolecules in aqueous environments, spectroscopy and structure determination, kinetics, membranes, and transport phenomena.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Pre-Requisite(s): (BL 1020 or BL 1040) and CH 1122 or (CH 1160 and CH 1161) and MA 2160 and PH 2200
CH 3541 - Biophysical Chemistry Laboratory
Examines the physical methods employed in the study of biological systems, including structure determination, spectroscopy, microscopy, imaging, and modeling. The core objective is application of the fundamentals developed in the Biophysical Chemistry course to systems of biological relevance.
Credits: 2.0
Lec-Rec-Lab: (0-0-4)
Semesters Offered: Spring
Co-Requisite(s): CH 3540

CH 4110 - Pharmaceutical Chemistry: Drug Action
Focuses on structural and mechanistic approaches to pharmaceuticals and drug action. General principles of absorption, distribution, action, metabolism and toxicity of drugs will be presented followed by action of drug classes such as antibiotics, cardiovascular, and anti-inflammatory drugs.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): BL 4010 or CH 4710

CH 4120 - Pharmaceutical Chemistry: Drug Design
Focuses on the important concepts in the design and synthesis of drugs. Rational basis for drug design including synthetic, computational and biochemical concepts will be discussed. Topics include structure-activity relationships, synthesis and reaction mechanism, and case studies of drugs.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): CH 2420

CH 4130 - Professional Development for Chemists 4: Senior Seminar
Continuation from CH3130 with emphasis on advanced topics of written and oral communication skills.
Credits: 2.0
Lec-Rec-Lab: (0-2-0)
Semesters Offered: Spring

CH 4140 - Introduction to Pharmaceutical Analysis
This course will present a systematic introduction to chemical analysis of pharmaceutical raw materials, finished pharmaceutical products, and of drugs in biological fluids, which are carried out in pharmaceutical laboratories worldwide.
Credits: 3.0
Lec-Rec-Lab: (2-0-2)
Semesters Offered: Spring
Restrictions: Must not be enrolled in one of the following Major(s): Biochem & Molec Biology-Chem, Pharmaceutical Chemistry, Chemistry, Cheminformatics
Pre-Requisite(s): CH 3130

CH 4190 - Current Topics in Pharmaceutical Chemistry
Discussion of recent topics in pharmaceutical chemistry.
Credits: variable to 3.0; Repeatable to a Max of 12
Semesters Offered: On Demand
Restrictions: Permission of instructor required; May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): CH 2410

CH 4210 - Instrumental Analysis
The lecture portion of CH4212; not open to undergraduate chemistry majors.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Pre-Requisite(s): CH 2212 and CH 3510(C) and CH 3511(C)

CH 4212 - Instrumental Analysis
Chemical instrumentation applied to organic and inorganic analysis with emphasis on chromatography and spectroscopy.
Credits: 5.0
Lec-Rec-Lab: (3-0-6)
Semesters Offered: Fall
Pre-Requisite(s): CH 2212 and CH 3510(C) and CH 3511(C)

CH 4222 - Bioanalytical Chemistry
An overview of modern analytical and instrumental techniques with emphasis on approaches relevant to measurements in biochemistry. Theory and methods of chromatographic separation methods, biomolecule quantification and electrochemical characterization. Error analysis and statistical treatment of data also covered.
Credits: 5.0
Lec-Rec-Lab: (3-0-6)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Major(s): Cheminformatics, Chemistry; May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): CH 1122 or (CH 1160 and CH 1161) and CH 3510(C) and CH 3511(C)

CH 4290 - Current Topics in Analytical Chemistry
Discussion of recent topics in analytical chemistry.
Credits: variable to 3.0; Repeatable to a Max of 12
Semesters Offered: On Demand
Restrictions: Permission of instructor required; May not be enrolled in one of the following Class(es): Freshman

CH 4292 - Independent Study in Analytical Chemistry
An undergraduate research experience in analytical chemistry. Students select a literature and/or laboratory problem and write a summary report.
Credits: variable to 3.0; Repeatable to a Max of 9
Semesters Offered: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

CH 4310 - Inorganic Chemistry I
Descriptive chemistry of the main group elements with some emphasis on the structure and theory of bonding with transition metal complexes. Examines bonding, physical and chemical properties, structure, and reactions of the chemical elements and their compounds.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Pre-Requisite(s): CH 3520

CH 4311 - Inorganic Chemistry Laboratory
Laboratory preparations (selected inorganic and organometallic compounds) that illustrate appropriate experimental techniques for synthesis of molecules; measurement of chemical properties, structures, and phenomena; hands-on experience with modern instrumentation; computational data analysis (by means of single crystal X-ray Diffraction experiments).
Credits: 2.0
Lec-Rec-Lab: (0-0-4)
Semesters Offered: Fall

CH 4320 - Inorganic Chemistry II
Continuation of CH4310. Descriptive chemistry of the transition group elements. Transition metal compounds; aspects of bonding, spectra, and reactivity; complexes of p-acceptor ligands; organometallic compounds and their role in catalysis; metals in biological systems; preparative, analytical, and instrumental techniques.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring

CH 4390 - Current Topics in Inorganic Chemistry
Discussion of recent topics in inorganic chemistry.
Credits: variable to 3.0; Repeatable to a Max of 12
Semesters Offered: On Demand
Restrictions: Permission of instructor required; May not be enrolled in one of the following Class(es): Freshman

CH 4412 - Spectroscopy of Organic Chemistry
Emphasizes use of spectral data interpretation to determine structures of organic compounds. Discusses proton and carbon nuclear magnetic resonance (including two-dimensional techniques, COSY, HETCOR, etc.), mass spectrometry, infrared spectrophotometry.
Credits: 3.0
Lec-Rec-Lab: (2-0-2)
Semesters Offered: Spring
Pre-Requisite(s): CH 2420

CH 4430 - Intermediate Organic Chemistry
Develop the chemical intuition necessary for advanced work in organic chemistry. Emphasizes reaction mechanisms and why reactions occur. Topics include heterocyclic chemistry, curved-arrow formalism and multi-step reactions, molecular orbitals and symmetry-controlled reactions, Hammett equation and structure-activity relationships, substitution reactions and carbonyl reactions.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring

CH 4490 - Current Topics in Organic Chemistry
Discussion of recent topics in organic chemistry.
Credits: variable to 3.0; Repeatable to a Max of 12
Semesters Offered: On Demand
Restrictions: Permission of instructor required; May not be enrolled in one of the following Class(es): Freshman

CH 4491 - Physical Organic Chemistry
Discussion of selected topics in molecular orbital theory, atomic and molecular spectroscopy, group theory, thermodynamics, statistical mechanics, the solid state, and other topics for students with previous coursework in physical chemistry.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Pre-Requisite(s): CH 3520

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CH 4515 - Atmospheric Chemistry
Study of the photochemical processes governing the composition of the troposphere and stratosphere, with application to air pollution and climate change. Covers radical chain reaction cycles, heterogeneous chemistry, atmospheric radiative transfer, and measurement techniques for atmospheric gases.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Class(es): Senior
Pre-Requisite(s): CH 3510 or CH 3520(C) or ENVE 4501 or ENVE 4504

CH 4519 - Transport and Transformation of Organic Pollutants
Assessment of factors controlling environmental fate, distribution, and transformation of organic pollutants. Thermodynamics, equilibrium, and kinetic relationships are used to quantify organic pollutant, partitioning, and transformations in air, water, and sediments. Use of mass balance equations to quantify pollutant transport.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2009-2010 academic year
Restrictions: Must be enrolled in one of the following Class(es): Senior
Pre-Requisite(s): ENVE 4501(C) or CH 3510

CH 4560 - Computational Chemistry
Focuses on the theory and method of modern computational techniques applied to the study of molecular properties and reactivity through lecture and computer projects. Covers classical mechanical as well as quantum mechanical approaches.
Credits: 3.0
Lec-Rec-Lab: (2-0-3)
Semesters Offered: Fall - Offered alternate years beginning with the 2010-2011 academic year
Pre-Requisite(s): CH 3520

CH 4590 - Current Topics in Physical Chemistry
Discussion of recent topics in physical chemistry.
Credits: variable to 3.0; Repeatable to a Max of 12
Semesters Offered: On Demand
Restrictions: Permission of instructor required; May not be enrolled in one of the following Class(es): Freshman

CH 4610 - Introduction to Polymer Science
Introductory study of the properties of polymers. Includes structure and characterization of polymers in the solid state, in solution, and as melts. Topics include viscoelasticity, rubbery elasticity, rheology and polymer processing. Applications discussed include coatings, adhesives, and composites.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Pre-Requisite(s): CH 1122 or (CH 1160 and CH 1161)

CH 4620 - Polymer Chemistry
Study of polymer chemistry dealing with the mechanisms of polymerization and copolymerization. Study of the chemistry of polymers, including polymer modification and degradation. Topics include methods for measuring and predicting the path of degradation and stabilization.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Pre-Requisite(s): CH 2420

CH 4631 - Polymer Science Laboratory
Students undertake experiments covering aspects of polymer characterization, processing, and recycling. Also included are experiments in applications such as coatings, adhesives, and composites.
Credits: 2.0
Lec-Rec-Lab: (0-1-3)
Semesters Offered: Fall - Offered alternate years beginning with the 2008-2009 academic year
Pre-Requisite(s): CH 4610(C) or CM 4610(C) or BE 4300(C) or MY 4600(C)

CH 4690 - Current Topics in Polymer Chemistry
Discussion of current topics in polymer chemistry.
Credits: variable to 3.0; Repeatable to a Max of 12
Semesters Offered: On Demand
Restrictions: Permission of instructor required; May not be enrolled in one of the following Class(es): Freshman

CH 4710 - Biomolecular Chemistry I
Examines chemical concepts underlying biomolecules and bioprocesses and interconnections between biology and chemistry. Bioorganic mechanisms and biophysical concepts in biochemistry are emphasized. Topics include biomolecules including proteins and nucleic acids and bioprocesses including catalysis and gene action.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Summer
Pre-Requisite(s): CH 2420

CH 4720 - Biomolecular Chemistry II
Focuses on structural and chemical logic of bioprocesses with emphasis on biogeneric mechanisms and the interconnections between biology and chemistry. Topics include metabolic pathways, membrane biophysics, ion-channels, cell communication, transcriptional control and molecular biology.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Class(es): Graduate
Pre-Requisite(s): CH 4710 and CH 2422

CH 4730 - Confocal Laser Scanning Microscopy: Foundations, Applications, and Advances
Principles of fluorescence microscopy, confocal microscope design, practical aspects of confocal microscopy, live cell imaging, high speed imaging, fluorescent stains, quantitative fluorescence, immunofluorescence, fluorescent proteins, biosensors. Confocal applications in biology and health related sciences will be covered.
Credits: 1.0
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall
Restrictions: Permission of instructor required; May not be enrolled in one of the following Level(s): Graduate

CH 4780 - Current Topics in Undergraduate Chemistry
Covers chemistry topics not included in regular courses. Topics may include designing organic syntheses, heterogeneous catalysis, homogeneous catalysis, solid-state chemistry, and heterocyclic chemistry.
Credits: variable to 3.0; Repeatable to a Max of 12
Semesters Offered: On Demand
Restrictions: Permission of instructor required; May not be enrolled in one of the following Class(es): Freshman

CH 4810 - Design and Operation of a High School Chemistry Lab
Hands-on experience in the operation of a high school chemistry laboratory. Includes the design and preparation of experiments and demonstrations, setting up and maintaining a chemical storeroom, chemical waste disposal, and safety issues. Required for certification in the ACS chemistry/education concentration.
Credits: 2.0
Lec-Rec-Lab: (0-0-6)
Semesters Offered: Spring - Offered alternate years beginning with the 2013-2014 academic year
Pre-Requisite(s): CH 2420 and CH 2411 and CH 3020

CH 4990 - Undergraduate Research in Chemistry
An undergraduate research experience in which students select a literature and laboratory research problem and write a report on the work performed. The student typically signs up for 1 to 3 credits per semester; most problems require more than one semester to complete. Requires GPA of 2.50 or better.
Credits: variable to 6.0; Repeatable to a Max of 12
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required

CH 4995 - Undergrad Research in Biochem
Undergraduate research experience in Biochemistry where students work on independent research projects under the direction of biochemistry faculty performing research in areas of biophysics, biochemical, and molecular biology. Instructor permission required.
Credits: variable to 6.0; Repeatable to a Max of 12
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required
Chemical Engineering

CM 1000 - Introduction to Chemical Engineering
Introduces chemical engineering as a profession using the theme of industrial chemical production. Covered concepts include process flow diagrams, unit operations, green engineering, and career opportunities. Guest speakers from industry will provide their perspectives on working as a chemical engineer.
Credits: 1.0
Lec-Rec-Lab: (1-0-0)
Semesters Offered: Fall

CM 2110 - Fund of Chem Engg 1
Application of chemical engineering fundamentals to the design and analysis of chemical processes. Mass balances, energy balances, and fundamentals concepts are applied. Introduces use of Process Flowsheet Simulation Software.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Summer
Pre-Requisite(s): CH 1112 or (CH 1150 and CH 1151)

CM 2120 - Fund of Chem Engg 2
Application of mass and energy balances to common chemical engineering operations. Mass balances, energy balances, and fundamental concepts are applied to flow in piping systems, pumps, compressors and stagewise separations (distillation, absorption/desorption, and extraction). Advanced use of Process Flowsheet Simulations software.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring, Summer
Pre-Requisite(s): CM 2110

CM 2200 - Intro Minerals and Materials
Fundamentals of minerals processing, raw materials production, and extractive metallurgy, including primary metals production.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall

CM 3110 - Transport/Unit Operations 1
Develop an understanding of the processes of momentum transfer (fluid mechanics) and heat transfer. Presents the basic equations of microscopic momentum and heat transfer, along with macroscopic transport equations that can be used in engineering analysis.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): CM 2120 and (MA 3520 or MA 3521 or MA 3530 or MA 3560) and MA 3160 and PH 2100

CM 3120 - Transport/Unit Operations 2
Mass transfer fundamentals applied to unit operations. Topics include Fick's Law, continuity equation with reaction and mass transfer co-efficients. Transient heat transfer and numerical solution are covered. Applications include absorption, distillation, extraction, adsorption, and membrane separations.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Major(s): Chemical Engineering
Pre-Requisite(s): CM 3110 and CM 2120 and (MA 3520 or MA 3521 or MA 3530 or MA 3560)

CM 3215 - Transport Laboratory
This course will be an introduction to basic laboratory methods and instrumentation used in the measurement of fluid flow, heat transfer, and mass transfer. Topics to be covered include methods of statistical data analysis, experimental design, principles of measurement and instrumentation, and presentation of data. Not open to students with credit in HU3120.
Credits: 2.0
Lec-Rec-Lab: (1-0-3)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Major(s): Chemical Engineering
Pre-Requisite(s): CM 2120(C) and CM 3110(C) and (MA 3520 or MA 3521 or MA 3530 or MA 3560)

CM 3220 - Thermodynamics for Chemical Engineers
First and second law applied to closed and open systems. Topics include energy conversion, power cycles, entropy and enthalpy calculations on engineering systems; property estimation for non-ideal vapors, liquids, and other substances, non-ideal multicomponent equilibria, chemical reaction equilibria.
Credits: 4.0
Lec-Rec-Lab: (4-0-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): CH 3510 and MA 3160 and (MA 3520(C) or MA 3521(C) or MA 3530(C) or MA 3560(C))

CM 3310 - Process Control
Covers methods of analyzing the transient behavior of chemical processing systems. Develops methods of analyzing systems and system components along with the special mathematical techniques needed. These concepts are then applied to illustrate mathematical modeling of large-scale chemical processing systems.
Credits: 3.0
Lec-Rec-Lab: (2-0-2)
Semesters Offered: Spring
Pre-Requisite(s): (MA 3520 or MA 3521 or MA 3530 or MA 3560) and PH 2200 and CM 2110 and CM 2120

CM 3410 - Technical Communication for Chemical Engineering
Study of the purposes, genres, and applications of technical communication in chemical engineering professions, including written, oral, visual, and graphic communication. Assignments may include memos, progress reports, procedures, memo and formal reports, research citations, and job-seeking requirements. Emphasizes organization, support, coherence, usefulness, ethics, and professionalism.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Senior
Pre-Requisite(s): UN 1015

CM 3450 - Computer-Aided Problem Solving in Chemical Engineering
The use of modern software packages in chemical engineering. Packages include spreadsheet, symbolic manipulator, chemical process calculator, statistical and modeling software. Course develops knowledge and skills in using computer tools that will complement chemical engineering courses and practice.
Credits: 3.0
Lec-Rec-Lab: (0-0-6)
Semesters Offered: Fall - Offered alternate years beginning with the 2008-2009 academic year
Pre-Requisite(s): CM 2110(C) and MA 2160

CM 3510 - Chemical Reaction Engineering
A study of chemical reaction engineering including design and analysis of chemical reactors, the fundamentals of chemical kinetics, and analysis of reaction rate data.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Pre-Requisite(s): CM 2110 and CM 3110 and CM 3230(C) and (MA 3520 or MA 3521 or MA 3530 or MA 3560) and PH 2140

CM 3820 - Sampling Statistics and Instrumentation
Solids sampling theory, practice, and instrumentation for process streams. Statistics/probability as they apply to representative samples from bulklots. Minimization of errors, proper design of sample collection apparatus, statistical design and analysis, and measurements of temperature, flow rate will be covered.
Credits: 3.0
Lec-Rec-Lab: (2-0-3)
Semesters Offered: Spring - Offered alternate years beginning with the 2006-2007 academic year

CM 3974 - Fuel Cell Fundamentals
This course provides an introduction to fuel cells and fuel cell systems. Topics include an overview of fuel-cell construction, fuel-cell chemistry, fuel-cell losses and efficiency, and integrating fuel cells into vehicles.
Credits: 1.0
Lec-Rec-Lab: (1-0-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): CH 1112 or (CH 1150 and CH 1151)

CM 4000 - Chemical Engineering Research
An undergraduate research experience on chemical engineering topics. Students work directly with faculty members on a research project. A report (written, poster, or oral) may be required.
Credits: variable to 3.0; Repeatable to a Max of 9
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required; May not be enrolled in one of the following Level(s): Graduate

CM 4020 - Undergraduate Research in Mineral Processing Engineering
An undergraduate research experience on mineral processing engineering topics. Students work directly with faculty members on a research project. A report (written, poster, or oral) may be required.
Credits: variable to 3.0; Repeatable to a Max of 9
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required; May not be enrolled in one of the following Level(s): Graduate
CM 4040 - Undergraduate Research in Biological Engineering
An undergraduate research experience on biological engineering topics. Students work directly with faculty members on a research project. A report (written, poster, or oral) may be required.

Credits: variable to 3.0; Repeatable to a Max of 9

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; May not be enrolled in one of the following Level(s): Graduate

CM 4060 - Undergraduate Research in Polymer Engineering
An undergraduate research experience on polymer engineering topics. Students work directly with faculty members on a research project. A report (written, poster, or oral) may be required.

Credits: variable to 3.0; Repeatable to a Max of 9

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; May not be enrolled in one of the following Level(s): Graduate

CM 4110 - Unit Operations Laboratory
Provides a rigorous introduction to experiments focused in the unit operations of fluid mechanics, heat transfer, mass transfer, and chemical reaction engineering.

Credits: 3.0

Lec-Rec-Lab: (0-1-6)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Major(s): Chemical Engineering

Pre-Requisite(s): CM 3120 and CM 3215 and CM 3230 and CM 3410(C) and CM 3510 and CM 4310(C)

CM 4120 - Chemical Plant Operations Lab
A capstone laboratory course focused on chemical manufacturing processes from the perspective of manufacturing excellence. Lecture material includes equality management, the application of statistical process control, and current trends in quality manufacturing. Experimental reinforcement of these concepts occurs in the department's pilot plants.

Credits: 3.0

Lec-Rec-Lab: (0-1-6)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Major(s): Chemical Engineering

Pre-Requisite(s): CM 3215 and CM 3310 and CM 4110

CM 4125 - Bioprocess Engineering Laboratory
An integrated biological process laboratory experience, including fermentation with downstream bioseparation, for the production of a purified product of potential commercial interest. Features process measurement-analysis-improvement, metabolic pathway analysis, quality assurance, and safety.

Credits: 1.0

Lec-Rec-Lab: (0-0-3)

Semesters Offered: Spring - Offered alternate years beginning with the 2005-2006 academic year

Pre-Requisite(s): CM 4710(C) or BL 3210 or BL 3310

CM 4310 - Chemical Process Safety/Env
A study of the technical fundamentals of chemical process safety and designing for the environment. Includes toxicology, industrial hygiene, source models, fires and explosions, relief systems, hazard identification, risk assessment, environmental fate and transport, hazardous waste generation, pollution prevention, and regulatory requirements.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

Pre-Requisite(s): CM 3120 and CM 3230

CM 4500 - Particle Technology
Fundamentals of particle processing, characterization, and separation. Topics include fine particle synthesis, mineral processing; automobile recycling; contaminated soils; recyclable materials such as batteries and tires; and sludges. Also covers zeta potential, particulate surface chemistry, flocculation, and dispersion.

Credits: 4.0

Lec-Rec-Lab: (3-3-3)

Semesters Offered: Fall, Spring - Offered alternate years beginning with the 2005-2006 academic year

CM 4550 - Introduction to Polymer Science
Introductory study of the properties of polymers. Includes structure and characterization of polymers in the solid state, in solution, and as melts. Topics include viscoelasticity, rubbery elasticity, rheology and polymer processing. Applications discussed include coatings, adhesives, and composites.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

Pre-Requisite(s): CH 1122 or (CH 1160 and CH 1161)

CM 4620 - Polymer Chemistry
Study of polymer chemistry dealing with the mechanisms of polymerization and copolymerization. Study of the chemistry of polymers, including polymer modification and degradation. Topics include methods of measuring and predicting the path of degradation and stabilization.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall, Spring

Pre-Requisite(s): CH 2420

CM 4631 - Polymer Science Laboratory
Students undertake experiments covering aspects of polymer characterization, processing, and recycling. Also included are experiments in applications such as coatings, adhesives, and composites.

Credits: 2.0

Lec-Rec-Lab: (0-1-3)

Semesters Offered: Fall - Offered alternate years beginning with the 2008-2009 academic year

Pre-Requisite(s): CM 4610(C) or CH 4610(C) or BE 4300(C) or MY 4600(C)

CM 4650 - Polymer Rheology
A systematic development of the principles and applications of the science of rheology. Reviews vector and tensor mathematics and Newtonian fluid dynamics. Develops the physical and mathematical nature of stress and deformations in materials. Covers the use of theory and application of rheological equations of state.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring

Pre-Requisite(s): (CM 3110 or MEEM 3210 or ENG 3200 or MY 3110 or CE 3600) and (MA 3520 or MA 3521 or MA 3530 or MA 3560)

CM 4655 - Polymer Rheology Laboratory
Basic techniques for acquisition of shear rheological data in torsional shear (cone-and-plate and parallel-plate) and capillary shear will be taught. Also covered will be sample preparation and handling techniques for polymers.

Credits: 1.0

Lec-Rec-Lab: (0-0-3)

Semesters Offered: Fall

Restrictions: Permission of instructor required; May not be enrolled in one of the following Class(es): Freshman, Sophomore

Pre-Requisite(s): CM 4610(C) or CH 4610(C) or CM 4650(C) or BE 4300(C) or MY 4600(C)

CM 4710 - Biochemical Processes
Presents an introduction to fundamental and applied aspects of industrial biochemical processing. Topics include cell structure and composition, enzymes and their use in industry, metabolism, bioreactor analysis and design, bioseparations for product recovery, industrial application, genetic engineering concepts, and applications.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2005-2006 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

Pre-Requisite(s): CM 3110(C)

CM 4740 - Hydrometallurgy/Pyrometallurgy
Extraction and refining of metals and industrial chemicals from natural and recycled materials. Includes solution-chemistry processes (hydrometallurgy) and thermochemical processes (pyrometallurgy).

Credits: 4.0

Lec-Rec-Lab: (3-1-0)

Semesters Offered: Spring

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

Pre-Requisite(s): CH 1122 or (CH 1160 and CH 1161)

CM 4770 - Analytical Microdevice Technologies
Course will provide background in micro/nano-scale technologies for biomedical diagnostic applications. Includes theoretical and experimental advances in chemical, mechanical, optical, and biological analysis. Reading of news and technical articles will develop skills/knowledge to envision microdevice applications for a semester-long project led by a graduate student team member.

Credits: 3.0

Lec-Rec-Lab: (1-1-2)

Semesters Offered: Fall, Spring - Offered alternate years beginning with the 2012-2013 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

Pre-Requisite(s): PH 2200
Construction Management

CMG 4780 - Biomanufacturing and Biosafety
This course will give students additional tools to perform as an engineer in a biomanufacturing facility. Focus is on mammalian cell culture derived products. Federal laws and compliance of biosafety in manufacturing facilities. Process design software will be introduced.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2014-2015 academic year
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): BL 2100 or CH 4710 or CM 4710 or (CM 3110(C) and BL 1040)
CMG 4855 - CM Process Analysis & Design I
Capstone technical and economic evaluations of processes and unit operations. Application of cost estimation, energy efficiency, and economic evaluation techniques. Teams analyze an existing facility, identify improvement opportunities, demonstrate the economic consequences, and recommend a course of action.
Credits: 3.0
Lec-Rec-Lab: (2-0-3)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Major(s): Chemical Engineering
Pre-Requisite(s): CM 3120 and CM 3230 and CM 3410(C) and CM 3510 and CH 2410
CMG 4860 - CM Process Analysis & Design 2
Process and project design principles applied to realistic problems, including project evaluation and management. Problems include safety, environmental, and operability constraints. Emphasizes the profit motive in industry and the role of the chemical engineer.
Credits: 2.0
Lec-Rec-Lab: (2-0-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Major(s): Chemical Engineering
Pre-Requisite(s): CM 4855
CMG 4861 - CM Design Laboratory 2
Individual/team projects to optimize designs for new ventures with realistic constraints. Requires process synthesis, market research, economic evaluation, and risk analysis techniques. Develops skills in problem solving, critical thinking, and communication. May include the AIChE National Student Design problem.
Credits: 1.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Major(s): Chemical Engineering
Pre-Requisite(s): CM 4860(C)
CMG 4900 - Interdisciplinary Design 1
Focuses on an interdisciplinary chemical engineering design project. (Senior project ready as defined by major substitutes for prerequisites)
Credits: variable to 3.0
Semesters Offered: Fall
Restrictions: Permission of department required; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior
CMG 4910 - Interdisciplinary Design 2
Focuses on an interdisciplinary chemical engineering design project. (Senior project ready as defined by major substitutes for prerequisites)
Credits: variable to 3.0
Semesters Offered: Spring
Restrictions: Permission of department required; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior
CMG 4990 - Special Topics in CM
Covers chemical engineering topics not included in regular courses, which may include biochemical engineering, design of biochemical reactions, composite materials, and numerical analysis of transport processes.
Credits: variable to 3.0; Repeatable to a Max of 12
Semesters Offered: On Demand
Restrictions: Permission of instructor required

CMG 1140 - Basic Construction Materials
Covers properties and behavior of basic construction materials, including wood, metals, aggregates, asphalt, concrete, and composites. Laboratory exercises include field testing techniques, materials standards, report writing, and presentation of data.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Spring
CMG 2100 - Building Utility Systems
Overview of the mechanical, electrical, and plumbing components of building systems. HVAC systems and controls, water supply and drainage, electrical power distribution and lighting, fire detection, alarm, and communications. Includes construction drawing interpretation and design projects.
Credits: 4.0
Lec-Rec-Lab: (0-4-0)
Semesters Offered: Fall
Pre-Requisite(s): PH 1240(C)
CMG 2120 - Statics and Strengths of Materials for Construction
Composition and resolution of forces and force systems, principles of equilibrium applied to various bodies, simple structures, friction, centroids, and moments of inertia. Mechanical behavior of materials, including consideration of stresses, strains, and deformations due to axial, torsional, and flexural loading.
Credits: 4.0
Lec-Rec-Lab: (0-3-2)
Semesters Offered: Spring
Pre-Requisite(s): PH 1110 or PH 1140
CMG 2140 - Building Materials & Methods
Materials, structural systems, building codes, and management procedures appropriate for residential and commercial construction. Includes construction drawing interpretation and graphic design project.
Credits: 4.0
Lec-Rec-Lab: (0-3-2)
Semesters Offered: Spring
Pre-Requisite(s): CMG 1140
CMG 2265 - Construction Quantity Survey
An introduction to the interpretation of construction drawings to perform quantity take-offs. Emphasis is on the civil and architectural components of building construction, with some discussion of other elements.
Credits: 3.0
Lec-Rec-Lab: (3-0-3)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Class(es): Sophomore, Junior, Senior
Pre-Requisite(s): CMG 1000 and CMG 1140
CMG 3200 - Site Planning and Development
An examination of land development issues including: site analysis, environmental concerns, contouring, earthwork and grading, soils, route alignments, storm water management, sewer systems, zoning, and land planning. Incorporates CAD applications in the lab.
Credits: 4.0
Lec-Rec-Lab: (0-3-2)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): SU 2000
CMG 3250 - Structural Analysis and Design
Elastic theory analysis and design of steel structural components, including tension, compression, truss frames, flexural beams, and connections. Includes an introduction to reinforced concrete structures and timber. All work is according to current applicable code manuals. Design projects include computer applications.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): CMG 2120 or MET 2120
CMG 3265 - Construction Cost Estimating
Advanced study of construction cost estimating topics. Includes conceptual estimating, unit price development, subcontract work, budgets, negotiated contracts, and related items. Extensive use of spreadsheets and estimating.
Credits: 4.0
Lec-Rec-Lab: (0-3-2)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): CMG 2265
CMG 4000 - Design-Build Project Delivery
Professional practice, financial, legal, and ethical considerations in construction management are illustrated and discussed in the context of the design-build delivery system.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Class(es): Senior
Pre-Requisite(s): CMG 3200(C)
CMG 4100 - Construction Equipment Management
Study of basic principles used in the construction industry for selecting and managing construction equipment. Focuses on understanding the time value of money, estimating equipment ownership and operating costs, selecting the proper equipment for specific tasks, and estimating equipment production.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): CMG 3265 and EC 3400

CMG 4120 - Construction Planning and Scheduling
This course will introduce students to the basics of construction scheduling. Topics covered will include: Fundamentals of different scheduling methods such as Critical Path Method and linear scheduling. Resource allocation in schedules, and Schedule monitoring and control methods.
Credits: 3.0
Lec-Rec-Lab: (2-0-2)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): CMG 3265 or CE 3332

CMG 4200 - Construction Contracts
Legal aspects of construction to include a study of construction documents, the project manual, report requirements, agreements, change orders, and other administrative functions in building construction.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): BUS 2200

CMG 4210 - Construction Project Management
Provides students with an understanding of the principles required to deliver a construction project on time, within budget, and with acceptable quality. Topics include construction law, contracts, delivery systems, job site layout and control, submittals, record keeping, subcontracting and purchasing, quality management, change orders, claims, and dispute resolution.
Credits: 4.0
Lec-Rec-Lab: (0-3-2)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): CMG 4200

CMG 4300 - Construction Finance and Accounting
Focuses on the principles of accounting and financial management needed to make construction projects and companies financially successful. Includes profitability, projecting costs, cash flow and cash requirements, and equipment costs.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): ACC 2000 and EC 3400

CMG 4400 - Construction Safety Management
Provides an awareness and understanding of workplace safety practices. Emphasis on the construction industry, including the OSHA construction regulations.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): CMG 4200

CMG 4800 - Sustainable Construction
An introduction to the philosophy and practice of sustainable building construction with emphasis on underlying socio-environmental philosophies, sustainable directed building technologies and materials, and case studies of contemporary green buildings to culminate in a simple sustainable design project.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): CMG 3200 and CMG 3250 and CMG 4120(C) and CMG 4210 and HU 3120

CMG 4906 - Special Topics in Construction Management
Selected additional topics of interest in Construction Management based on student and faculty demand and interest. May be a tutorial, seminar, workshop, project, or class study.
Credits: variable to 3.0; Repeatable to a Max of 6
Semesters Offered: On Demand
Restrictions: Permission of instructor required; Must be enrolled in one of the following Major(s): Construction Management; Must be enrolled in one of the following Class(es): Senior

CMG 4997 - Independent Study in Construction Management
Independent study of an approved topic under the guidance of a Construction Management faculty member. May be either an academic, design or research problem/project.
Credits: variable to 3.0; Repeatable to a Max of 6
Semesters Offered: On Demand
Restrictions: Permission of instructor required; Must be enrolled in one of the following Major(s): Construction Management; Must be enrolled in one of the following Class(es): Senior

CMG 4998 - Undergraduate Research in Construction Management
An undergraduate research experience in Construction Management. Under the guidance of a Construction Management faculty member, students work on a selected/approved research project or work directly with faculty on active research projects/grants. May require more than one semester to complete.
Credits: variable to 6.0; Repeatable to a Max of 6
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Class(es): Sophomore, Junior, Senior

Computer Science

CS 1000 - Explorations in Computing
An introduction to the study of computing: fundamental concepts and skills; opportunities at Michigan Tech; career opportunities; social and ethical issues.
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Class(es): Freshman

CS 1090 - Special Topics in Computer Science
Special topics in computer science offered on occasion based on student and faculty demand and interest.
Credits: variable to 3.0; May be repeated
Semesters Offered: On Demand
Restrictions: Permission of instructor required

CS 1111 - Introduction to Programming in C/C++
Introductory course in C++ programming. Topics include top-down analysis of problems, structured programming, control structures, functions, arrays, pointers, and file I/O. Basic concepts of object-oriented programming (classes, objects, function overloading) will also be introduced.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Major(s): Computer Engineering, Computer Science, Computer Systems Science, Computer Network & System Admin, Industrial Technology, Electrical Engineering; Must be enrolled in one of the following Class(es): Freshman, Sophomore

CS 1121 - Introduction to Programming I
Starting point of the computer science programs. A high-level, object-oriented programming language is introduced as a problem-solving tool. Topics include design, coding, documentation, debugging, and testing of programs. Programming assignments are given in both a closed lab setting and as homework.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): MA 1031(C) or MA 1032(C)
CS 1122 - Introduction to Programming II
Continuation of CS 1121. Topics include data abstraction, class hierarchies and polymorphism, list, stack, queue and tree data structures, complexity-based algorithm and data structure choices, and recursion. Homework programming assignments are given.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): CS 1121

CS 1131 - Accelerated Introduction to Programming
An alternative starting point of the computer science programs for students with some programming experience, combining material from CS1121 and CS1122, offered at an accelerated pace. Homework programming assignments are given.
Credits: 5.0
Lec-Rec-Lab: (0-4-2)
Semesters Offered: Fall
Restrictions: Permission of department required
Pre-Requisite(s): MA 1031 or MA 1032 or MA 1160(C) or MA 1161(C)

CS 1141 - C for Java Programmers
Programming in C for students with prior experience in Java. Topics include program structure, the preprocessor, arrays, structures, pointers, input/output, dynamic memory management, and linked data structures.
Credits: 2.0
Lec-Rec-Lab: (0-2-0)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): CS 1122 or CS 1131

CS 2090 - Special Topics in Computer Science
Special topics in computer science offered on occasion based on student and faculty demand and interest.
Credits: variable to 3.0; May be repeated
Semesters Offered: On Demand
Restrictions: Permission of instructor required

CS 2311 - Discrete Structures
Presents fundamental concepts in discrete structures that are used in computer science. Topics include sets, trees, graphs, functions, relations, recurrences, proof techniques, logic, combinatorics, and probability.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): (CS 1121 or CS 1131) and (MA 1135 or MA 1160 or MA 1161)

CS 2321 - Data Structures
Presents fundamental concepts in data structures. Topics include abstract data types (priority queues, dictionaries and graphs) and their implementations, algorithm analysis, sorting, text processing, and object oriented design. A significant programming project is assigned.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): CS 1122 or CS 1131

CS 3000 - Ethical and Social Aspects of Computing
An examination of social and ethical issues associated with computing. Topics include: ethical theories and decision making, intellectual property, freedom of expression, privacy, security, and professional responsibility.
Credits: 2.0
Lec-Rec-Lab: (0-2-0)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): CS 3141

CS 3090 - Special Topics in Computer Science
Special topics in computer science offered on occasion based on student and faculty demand and interest.
Credits: variable to 3.0; May be repeated
Semesters Offered: On Demand
Restrictions: Permission of instructor required

CS 3141 - Team Software Project
This course introduces software design techniques (e.g., Design-By-Contracts), uses the UML for requirements and design specification, and requires implementation, unit testing and documentation in the context of a significant team project. Other topics: teamwork, user interfaces, social and professional responsibility.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): CS 2311 and CS 2321

CS 3311 - Formal Models of Computation
Introduction to the theory of formal languages and computation. Topics include regular languages and finite automata, context-free languages and push-down automata, Turing-acceptable languages, Turing machines and the halting problem. Proof techniques and applications, such as parsing, are also treated.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): CS 2311

CS 3331 - Concurrent Computing
Concepts and techniques in concurrent computing. Topics include: processes and threads, mutual exclusion, semaphores, monitors and condition synchronization, deadlock, safety and liveness, message passing, and concurrent architectures.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): CS 1141 and CS 2311 and CS 2321

CS 3411 - Systems Programming
Development of robust programs that provide efficient services to system software developers. Topics include: file I/O, process creation and management, linking and libraries, interprocess communication, performance measurement, and socket programming.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): CS 1141 and CS 3421

CS 3421 - Computer Organization
Introduction to the logical structure of computers, including the fundamentals of logic design, information storage and manipulation, control, input/output, and assembly language programming. Topics include a review of current hardware technology, combinational and sequential logic, arithmetic, datapaths, hardwired control, interrupts, caches, virtual memory, and an introduction to pipelining.
Credits: 4.0
Lec-Rec-Lab: (0-4-0)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): CS 1122 or CS 1131

CS 3425 - Introduction to Database Systems
This course provides an introduction to database systems including database design, query, and programming. Topics include goals of database management; data definition; data models; data normalization; data retrieval and manipulation with relational algebra and SQL; data security and integrity; database and Web programming; and languages for representing semi-structured data.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): CS 1122 and CS 2341

CS 3451 - Computer Administration
Administration of non-networked computers. Topics include: operating system installation; boot-up and shutdown; process management; account management; file systems; storage technology; backups; serial devices.
Credits: 4.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): CS 3411(C)

CS 4090 - Special Topics in Computer Science
Special topics in computer science offered on occasion based on student and faculty demand and interest.
Credits: variable to 4.0; May be repeated
Semesters Offered: On Demand
Restrictions: Permission of instructor required

CS 4099 - Directed Study in Computer Science
Students study one or more special topics in computer science under the direction of one or more faculty members.
Credits: variable to 4.0; Repeatable to a Max of 6
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required

CS 4121 - Programming Languages
A discussion of the concepts underlying programming languages. Topics include: programming paradigms; language properties (including syntax, semantics, run-time behavior, and implementation issues); data, procedure, functional, and control abstraction; functional programming; and logic programming.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): CS 1141 and CS 2321 and CS 3421 and CS 3311
CS 4130 - Compiler Design and Optimization
Design, theory, and implementation of programming language translators. Topics include: intermediate representations, advanced code generation, control and data-flow analysis, advanced compiler optimization, dynamic compilation, global register allocation and instruction scheduling. A major project is required.
Credits: 4.0
Lec-Rec-Lab: (0-3-3)
Semesters Offered: Fall, Spring
Restrictions: May not be enrolled in one of the following Class(es): Graduate Pre-Requisite(s): CS 4121

CS 4321 - Introduction to Algorithms
Fundamental topics in algorithm design, analysis, and implementation. Analysis fundamentals include asymptotic notation, analysis of control structures, solving recurrences, and amortized analysis. Design and implementation topics include sorting, searching, and graph algorithms. Design paradigms include greedy algorithms, divide-and-conquer algorithms, and dynamic programming.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Restrictions: May not be enrolled in one of the following Class(es): Graduate Pre-Requisite(s): CS 2311 and CS 2321

CS 4331 - Introduction to Parallel Programming
Introduction to developing parallel programs and solving problems using multiple concurrent processes. Shared memory and message passing paradigms are studied. Topics include conceptual models of parallel programming, basic analysis of parallel languages, parallel computer architecture, domain decomposition, and load balancing. Traditional computer science applications and numerical applications are also studied.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Pre-Requisite(s): CS 3331 and CS 3421 and CS 4321

CS 4411 - Operating Systems
Principles of the design and implementation of operating systems. Topics include: process management, process scheduling, memory management, I/O, file systems. Includes a significant implementation component.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): CS 3331 and CS 3421

CS 4425 - Database Management System Design
This course covers the design issues concerning the implementation of database management systems, including distributed databases. The topics include data storage, index implementation, query processing and optimization, security, concurrency control, transaction processing, and recovery.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Pre-Requisite(s): CS 3425

CS 4431 - Computer Architecture
Advanced course in architecture of high-performance computer systems. Topics include instruction-set design, simulation of processor architectures, multiple functional units, pipelining, dynamically scheduled pipelines, speculative execution, multi-core and multi-processor systems, advanced I/O subsystems and analytic models of architectural features of processors.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): CS 3421

CS 4451 - Network Administration
Administration of computer networks. Topics include: TCP/IP networking, mail, printing, configuring and building kernels, remote file systems, license management, managing web systems, common network administration services, and network performance analysis.
Credits: 4.0
Lec-Rec-Lab: (0-3-3)
Semesters Offered: Spring
Pre-Requisite(s): CS 3451 and CS 4461(C)

CS 4461 - Computer Networks
Computer network architectures and protocols; design and implementation of datalink, network, and transport layer functions. Introduction to the Internet protocol suite (TCP, UDP, IP), domain name service and protocols, file sharing protocols, wireless networks, and network security.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): CS 3411

CS 4471 - Computer Security
Development and administration of secure software systems. Topics include principles of software development, practical cryptography, program security, operating system security, database security, administration, legal and ethical issues.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): CS 3411 or CS 4411

CS 4496 - GPU and Multicore Programming
Introduction to Graphics Processing Units (GPU) and multi-core systems, their architectural features and programming models, stream programming and compute unified driver architecture (CUDA), caching architectures, linear and non-linear programming, scientific computing on GPUs, sorting and search, stream mining, cryptography, and fixed and floating point operations.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Class(es): Graduate Pre-Requisite(s): CS 3411 and CS 3421

CS 4611 - Computer Graphics
Introduction to interactive computer graphics. Topics include 3D viewing, 3D transformation, interactive techniques, animation, modeling, lighting, texturing, vertex programs, fragment programs, and graphics algorithms. Requires substantial programming homework.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Class(es): Graduate, Sophomore Pre-Requisite(s): CS 1141 and CS 2321 and MA 2330

CS 4710 - Model-Driven Software Development
Focuses on the use of formal models throughout the software development life cycle. Topics include formal specification of requirements, behavioral modeling, automated analysis, architectural styles and design specification.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Pre-Requisite(s): CS 3311 and CS 3141(C)

CS 4711 - Software Processes and Management
Focuses on the software development process and related management issues. Topics include software process models, the Capability Maturity Model, process tools, use of standards, software maintenance, configuration management, project planning and tracking, team management, and measurement and estimation.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Pre-Requisite(s): CS 3141

CS 4712 - Software Quality Assurance
Covers the notion of software quality and how to ensure quality through the software process. Topics include requirements elicitation, analysis and documentation; usability and accessibility; testing; and quality assurance management.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Pre-Requisite(s): CS 3141

CS 4750 - Teaching Methods in Computer Science
Provides teaching methods, models, and experiences for teaching computer science in secondary schools. Topics discussed include teaching methods, learning, security and maintenance of equipment, professional journals, ethics, legal issues, diversity, and problem solving. Requires admission to the Teacher Education Program.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Permission of department required; May not be enrolled in one of the following Class(es): Graduate Pre-Requisite(s): CS 4750

CS 4760 - Human-Computer Interactions
Principles of user interfaces (UI) design and implementation. Topics include: UI theory, design principles, evaluation, and tools. Requires completion of a group project implementing and evaluating a UI.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): CS 3141
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Lec-Rec-Lab:</th>
<th>Semesters Offered:</th>
<th>Restrictions:</th>
<th>Pre-Requisite(s):</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS 4791</td>
<td>Senior Software Engineering Project I</td>
<td>3.0</td>
<td>(0-1-4)</td>
<td>On Demand</td>
<td>Permission of instructor required</td>
<td>CS 4710 or CS 4711 or CS 4712</td>
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<tr>
<td>CS 4792</td>
<td>Senior Software Engineering Project II</td>
<td>3.0</td>
<td>(0-1-4)</td>
<td>Fall, Spring</td>
<td>Permission of instructor required</td>
<td>CS 4791</td>
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<tr>
<td>EC 4811</td>
<td>Artificial Intelligence</td>
<td>3.0</td>
<td>(0-3-0)</td>
<td>Spring</td>
<td>May not be enrolled in one of the following Class(es): Freshman, Sophomore</td>
<td>CS 2321 and CS 3311</td>
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<tr>
<td>CS 4821</td>
<td>Data Mining</td>
<td>3.0</td>
<td>(0-3-0)</td>
<td>Spring</td>
<td>Permission of instructor required</td>
<td>(MIS 3100 or CS 3425) and (MA 2330 or MA 2320 or MA 2321) and (MA 2710 or MA 2720 or MA 3710) and MA 3740</td>
</tr>
</tbody>
</table>

**Economics**

**EC 2001 - Principles of Economics**
An introduction to economics. The microeconomics portion covers consumer choice, the firm, value and price theory, and distribution theory. The macroeconomics portion covers national income analysis, fiscal policy, money and monetary policy, the commercial banking system, and the Federal Reserve System.

Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): MA 1020 or MA 1031 or MA 1032 or MA 1135(C) or MA 1160(C) or MA 1161(C)

**EC 3002 - Microeconomic Theory**
The study of consumer and producer choices, market demand and supply, and market structures.

Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Pre-Requisite(s): EC 2001 and (MA 1135 or MA 1160 or MA 1161) and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

**EC 3003 - Macroeconomic Theory**
Analysis of the determinants of the level of output, employment, prices, and economic growth with an emphasis on fiscal policy and monetary policy.

Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Pre-Requisite(s): EC 2001 and (MA 1135 or MA 1160 or MA 1161) and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

**EC 3100 - International Economics**
Introduction to international economics, including balance of payments, accounting, foreign exchange markets, international trade theory, barriers to trade, trade and development, regional economic integration, and current U.S. international economic issues.

Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): EC 2001 and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

**EC 3300 - Industrial Organization**
Economic analysis of market power and industry structure. Topics include the goals of public policy toward business, antitrust policy, economic regulation, public enterprise, and social regulation of health, safety, and the environment.

Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): EC 2001 and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

**EC 3400 - Economic Decision Analysis**
Studies economic decision-making for actions occurring over time. Covers decision tools for comparing alternatives, public project evaluation, risk and uncertainty, mutually exclusive decisions, multiple objective decisions, interest rate calculations, cash flow analysis, depreciation and taxes, cost of capital, capital budgeting.

Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: May not be enrolled in one of the following Major(s): Finance, Operations and Systems Mgmnt, Management Information Systems, Marketing, Accounting, Management; May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

**EC 4000 - Senior Seminar in Economics**
A senior capstone seminar in which students discuss and conduct research under the guidance of several faculty members.

Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Major(s): Economics;
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

**EC 4100 - Mathematical Economics**
Application of the principal mathematical techniques used in economic theory and modeling. Topics include optimization, marginal analysis, comparative statics, and other applications.

Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Pre-Requisite(s): EC 3002 and EC 3003 and (MA 1160 or MA 1161 or MA 1135)

**EC 4200 - Econometrics**
Introduces techniques and procedures to estimate and test economic and financial relationships developed in business, economics, social and physical sciences.

Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Pre-Requisite(s): EC 2001 or EC 3002 or EC 3003) and (BUS 2100 or MA 2710 or MA 2720 or MA 3710) and (MA 1135 or MA 1160 or MA 1161)

**EC 4400 - Banking and Financial Institutions**
Analysis of asset and liability management of financial institutions and the role of financial institutions in the U.S. and international economy.

Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Pre-Requisite(s): EC 3003 or FIN 3000 and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

**EC 4500 - Public Economics**
Economic analysis of how democratic governments generate revenue (primarily taxation) and make expenditure decisions and how such decisions impact the welfare of individuals. Topics include market failures, voting processes, income redistribution programs, efficiency and incidence of taxation.

Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Pre-Requisite(s): EC 2001 and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)
EC 4620 - Energy Economics
Introduction to the institutional, technical, and economic issues of the production and use of energy resources, including petroleum, natural gas, coal, nuclear, electric utilities, and alternative energy sources. Applies economic analysis to industrial and policy problems of the supply, distribution, and use of energy resources, including environmental and social consequences.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Pre-Requisite(s): EC 2001 and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

EC 4630 - Mineral Industry Economics
Studies the role of minerals and metals in society and the economics of their use. Applies economic principles to examine the supply, demand, markets, and foreign trade for important minerals and metals. Examines the effect of government policies on the minerals industries. Requires a technical report.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring - Offered alternate years beginning with the 2009-2010 academic year
Pre-Requisite(s): EC 2001 and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

EC 4640 - Natural Resource Economics
Studies the economics of nonrenewable resources (energy and minerals) and renewable resources (water, fisheries, forests and species). Discusses the economics of land use change, macroeconomic topics such as economic growth, sustainability and green accounting.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Pre-Requisite(s): (EC 2001 or EC 3002 or FW 4080) and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

EC 4650 - Environmental Economics
Considers the efficient and equitable use of environmental resources, including air, water, land, wilderness and parks, wildlife and other ecological systems. Measures the benefits and costs of decreasing pollution, cleaner environment, and protecting scarce ecological resources. Addresses market failures and the economic valuation of environmental amenities.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Pre-Requisite(s): (EC 2001 or EC 3002) and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

EC 4710 - Labor/Human Resource Economics
Economic analysis of labor markets and human resources. Topics include the supply and demand for labor, wage determination, human capital theory, returns to education and training, causes of wage differentials, and economic effects of discrimination.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: On Demand
Pre-Requisite(s): EC 2001 and (MA 2710 or MA 2720 or MA 3710) and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

EC 4900 - Research
Under the general guidance of a faculty member, students read, conduct research, and prepare reports and papers as required.
Credits: variable to 4.0; Repeatable to a Max of 6
Semesters Offered: On Demand
Pre-Requisite(s): EC 2001

EC 4900 - Special Topics in Economics
Economic topics of interest to students and faculty.
Credits: variable to 4.0; Repeatable to a Max of 6
Semesters Offered: On Demand
Pre-Requisite(s): EC 2001

Education

ED 0510 - Graduate Teaching Assistant Training
Half semester course for training graduate teaching assistants (GTAs). Covers course preparation, educational testing and evaluation, instructional strategies (discussions, lecturing, collaborative learning, cases/simulations, etc.), using instructional technologies, motivating students, and institutional resources.
Credits: 1.0
Lec-Rec-Lab: (0-15-0)
Semesters Offered: Fall, Spring
Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

ED 2010 - Field Study in Education: Elementary School
Observations in an elementary school, offering relevant school experience to help clarify career goals.
Credits: 1.0
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring
Restrictions: Permission of department required

ED 2020 - Field Study in Education: Secondary School
Observations in a secondary school, offering relevant school experience to help clarify career goals.
Credits: 1.0
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring
Restrictions: Permission of department required

ED 3100 - Instructional Technology
Provides the development of knowledge and skills required to make use of information and communication technologies as instructional tools. Use of instructional technology will be considered within a context of relevant research and theory pertaining to human learning. Examines various technologies used to produce, present, and distribute instruction.
Credits: 2.0
Lec-Rec-Lab: (0-2-0)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

ED 3110 - Psychological Foundations of Learning
The course examines how human beings grow and learn with major emphasis on the early adolescent and adolescent. Psychological basis of educational procedures and practices are established with special reference to learning disorders, gifted children, and culturally diverse classrooms.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

ED 3210 - Foundations of Education
Contemporary issues in education from historical, philosophical, sociological and legal perspectives. Emphasizes the structure/function of U.S. education as well as exceptional children, especially the handicapped and culturally different. This course is one component of the Teacher Education Early Block. Requires admission to teacher education program.
Credits: 2.0
Lec-Rec-Lab: (0-2-0)
Semesters Offered: Fall
Restrictions: Permission of department required; May not be enrolled in one of the following Class(es): Freshman, Sophomore

ED 3410 - Clinical Experience
Observation, tutoring and classroom teaching in an area school classroom. Observation, tutoring and classroom teaching in an area school classroom. Requires admission to the Teacher Education Early Block. Requires admission to the Teacher Education program.
Credits: 1.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Fall, Spring
Restrictions: Permission of department required; May not be enrolled in one of the following Class(es): Freshman
Co-Requisite(s): ED 3110, ED 3410
Pre-Requisite(s): ED 3110(C) and ED 3410(C)

ED 3410 - Clinical Experience
Observation, tutoring and classroom teaching in an area school classroom. Requires admission to the Teacher Education Early Block. Requires admission to the Teacher Education program.
Credits: 1.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Fall, Spring
Restrictions: Permission of department required; May not be enrolled in one of the following Class(es): Freshman
Co-Requisite(s): ED 3110, ED 3210

ED 3510 - Communicating Science I
Students design hands-on presentations for K-8 students and their parents at family science nights conducted at area schools and other events in a 4-county area (off campus 4:30-9:00PM). The course highlights presentation skills, teaching techniques, learning styles, and classroom management.
Credits: 3.0
Lec-Rec-Lab: (1-0-2)
Semesters Offered: Fall, Spring
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

ED 3511 - Communicating Science II
Students will make presentations in local K-8 classrooms and/or at evening family science nights conducted at area schools. Classroom lectures will highlight the rationale for interacting with schools and communities as a professional, presentation skills, effective teaching techniques, learning styles, classroom management techniques, and model hands-on learning techniques.
Credits: 1.0
Lec-Rec-Lab: (0-0-1)
Semesters Offered: Fall, Spring, Summer
ED 4020 - Methods of Teaching Social Studies
Application of learning and instructional theories and practice to the teaching of social studies. Emphasis will include application of state and national education standards and relevant assessment strategies for social studies.
Requires admission to the Teacher Education program by the Department of Education.
Credits: 2.0
Lec-Rec-Lab: (0-2-0)
Semesters Offered: On Demand
Restrictions: Permission of department required
Pre-Requisite(s): ED 4700(C)

ED 4140 - Methods of Teaching English
Application of learning theories and national and state professional standards to the teaching of English. Emphasizes methods, materials, and media used to teach adolescents. Requires admission to teacher education program or permission of instructor.
Credits: 4.0
Lec-Rec-Lab: (0-3-3)
Semesters Offered: Fall
Restrictions: Permission of department required
Pre-Requisite(s): ED 4700(C)

ED 4150 - Literacy in the Content Areas
An introduction to the best ways to use language for deepening comprehension and understanding of all the content areas. Includes inquiries into how cultural and learning differences relate to comprehension. A minimum of 28 tutoring hours in a local school is required.
Credits: 4.0
Lec-Rec-Lab: (0-3-1)
Semesters Offered: Fall, Spring
Pre-Requisite(s): ED 3110 and ED 3210 and ED 3410

ED 4510 - Special Topics in Education
Students identify and develop an in-depth examination of current topics in education for further research and study. Working in consultation and agreement with select faculty, students engage in active inquiry on leading educational issues.
Credits: variable to 6.0; Repeatable to a Max of 9
Semesters Offered: Fall, Spring

ED 4700 - Fundamentals of Instruction
Study of key areas of instruction in preparation for student teaching. Emphasis is placed on lesson planning, classroom management, and student assessment and evaluation. Requires admission to the teacher education program by the Department of Education.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Fall, Spring
Restrictions: Permission of department required; May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): ED 3110 and ED 3210 and ED 3410

ED 4720 - Methods of Teaching Science
Application of learning and instructional theories to the teaching of science.
Credits: 2.0
Lec-Rec-Lab: (1-0-2)
Semesters Offered: Fall
Restrictions: Permission of department required; May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): ED 4700(C)

ED 4750 - Teaching Methods in Computer Science
Provides teaching methods, models, and experiences for teaching computer science in secondary schools. Topics discussed include teaching methods, learning, security and maintenance of equipment, professional journals, ethics, legal issues, diversity, and problem solving. Requires admissions to the Teacher Education Program.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Permission of department required; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior
Pre-Requisite(s): ED 4700

ED 4850 - Environmental Education Methods
This course will prepare students to design and conduct environmental education programs for adults and youth in classrooms, parks, museums, nature centers, and through statewide outreach programs using a variety of teaching methods, hands-on-activities, and scientific investigations.
Credits: 4.0
Lec-Rec-Lab: (2-1-1)
Semesters Offered: On Demand
Restrictions: Permission of department required; May not be enrolled in one of the following Class(es): Freshman, Sophomore

ED 4910 - Directed Teaching
Knowledge of human growth and learning theories, methods and materials, and individual differences applied to classroom settings conducted under the supervision of an experienced middle or secondary school teacher. Requires admission to teacher education program.
Credits: 12.0
Lec-Rec-Lab: (0-0-36)
Semesters Offered: Fall, Spring
Restrictions: Permission of department required; May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): ED 3100 and ED 3210 and (ED 4700 or HU 4140 or SS 4020(C) or MA 4905)

Electrical & Computer Engineering

EE 1110 - Essential Mathematics for Electrical Engineering
Review of basic trigonometry, sinusoidal signals, amplitude, frequency and phase, addition of sinusoids. Complex numbers and complex arithmetic. Real exponential functions, complex exponentials, Euler’s relations, decaying sinusoids and complex exponential functions. Differentiation and integration of sinusoids and exponentials.
Credits: 1.0; Graded Pass/Fail Only
Lec-Rec-Lab: (2-0-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Class(es): MA 1160 or MA 1161

EE 1111 - Introduction to Electrical and Computer Engineering
A half-semester course intended to provide an introduction to the profession of Electrical Engineering and Computer Engineering freshmen or sophomore students. The goals of this course are to provide perspective into the various subareas within ECE and highlight the technical, professional, and ethical behavior expected of the graduate.
Credits: 1.0
Lec-Rec-Lab: (2-0-0)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Major(s): Electrical Engineering, Computer Engineering; Must be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): MA 1160 or MA 1161

EE 2111 - Electric Circuits I
This course will cover basic electrical concepts, resistive circuits, nodal and loop analysis techniques, superposition, Thevenin and Norton equivalents, maximum power transfer, capacitance and inductance, AC steady-state analysis, steady-state power analysis.
Credits: 3.0
Lec-Rec-Lab: (3-0-2)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): EE 1110 and MA 2160

EE 2112 - Electric Circuits II and Lab
This course will cover operational amplifiers, first and second order transient circuits, magnetically coupled networks, polyphase circuits, variable frequency network performance, the Laplace transform, application of the Laplace transform to circuit analysis, Fourier analysis techniques, two port networks.
Credits: 4.0
Lec-Rec-Lab: (3-0-2)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): EE 2111 and (MA 3520 or MA 3521 or MA 3530 or MA 3560)

EE 2174 - Digital Logic and Lab
Introduces analysis, design, and application of digital logic. Includes Boolean algebra, binary numbers, logic gates, combinational and sequential logic, storage elements and hardware-description-language based synthesis.
Credits: 4.0
Lec-Rec-Lab: (3-0-2)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): EET 2241(C) or EE 2241(C) or CS 1121(C) or CS 1131(C) or CS 1111(C)

EE 3010 - Circuits and Instrumentation
Designed for nonmajors. Covers the principles of electrical and electronic measurements, including dc, ac, semiconductor devices, amplifiers, and filtering.
Credits: 3.0
Lec-Rec-Lab: (2-0-2)
Semesters Offered: Fall, Spring, Summer
Restrictions: May not be enrolled in one of the following Major(s): Electrical Engineering, Computer Engineering
EE 3090 - Geometrical and Wave Optics
First order geometrical optics including image formation: introduction to third order aberrations, interference, polarization, spatial and temporal coherence, lasers and Gaussian beam propagation; diffraction; optical sources and detectors; selected applications of optics.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Pre-Requisite(s): EE 3140(C) and (MA 3520 or MA 3521 or MA 3530 or PH 2200(C))

EE 3120 - Electric Energy Systems
An overview of the generation and utilization of electrical energy. Covers three-phase circuits, transformers, photovoltaics, batteries, electromechanical energy conversion, and an overview of electric power systems, including economic issues.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): EE 2110 or EE 3010 or (EE 2111 and EE 2112(C))

EE 3131 - Electronics
Covers the fundamentals of electronic devices and circuits; operational amplifiers, bipolar junction transistors, diodes, and MOSFETs.
Credits: 4.0
Lec-Rec-Lab: (3-0-2)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): EE 2112 or EE 3010

EE 3140 - Electromagnetics
Covers basic principles of engineering electromagnetics with an emphasis on Maxwell's equations.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): PH 2200 and MA 3160 and (EE 2110 or EE 2112)

EE 3160 - Signals and Systems
Introduces the mathematical analysis of signals, systems, and control. Topics include differential equations, Fourier series, Fourier transforms, Laplace transforms, frequency response, Bode plots, state models, and an introduction to control systems.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): (EE 2110 or EE 2112) and (MA 2320 or MA 2321 or MA 2330) and (MA 3520 or MA 3521 or MA 3530 or MA 3560)

EE 3171 - Microcontroller Applications
Introduces the concepts of microcontroller-based systems. Describes basic characteristics of microcontrollers, then goes into significant detail in the applications of a specific microcontroller. Topics include C and assembly language programming, instruction set interface, ASICS, and polled, interrupt, and DMA input/output.
Credits: 4.0
Lec-Rec-Lab: (3-0-2)
Semesters Offered: Fall, Spring, Summer
Restrictions: May not be enrolled in one of the following Major(s): Computer Engineering
Pre-Requisite(s): (EE 2241 or CS 1121 or CS 1111) and (EE 2174 or EE 2173)

EE 3173 - Hardware/Software System Integration
Covers the integration of hardware and software into a complete working system. Includes design and construction of I/O devices for microprocessor or microcontroller-based systems, communication and bus protocols, programming in assembler language and in "C", system integration and testing. Also covers the use of FPGAs and HDL design tools.
Credits: 4.0
Lec-Rec-Lab: (3-0-3)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Major(s): Electrical Engineering, Computer Engineering
Pre-Requisite(s): (EE 2304 or EE 2174) and (EE 3130 or EE 3131) and (CS 1141 or CS 2141) and CS 3421 and (MA 3710 or EE 3180)

EE 3180 - Introduction to Probability and Random Signal Analysis
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): EE 3160

EE 3190 - Optical Sensing and Imaging
Optical sensing techniques, including imaging and non-imaging systems.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Pre-Requisite(s): EE 3090

EE 3250 - Introduction to Communications Theory
Introduction to communications systems and theory; fundamentals of point-to-point communication link design and analysis; analog modulation and demodulation techniques; digital signal representation and filtering; binary data transmission.
Credits: 3.0
Lec-Rec-Lab: (3-0-2)
Semesters Offered: Fall, Spring
Pre-Requisite(s): EE 3160 and EE 3180(C)

EE 3261 - Control Systems
Mathematical formulation of control problems (both transfer function and state-variable descriptions); analysis of feedback control systems (stability, transient performance, steady-state error, sensitivity, etc.); analog and digital simulation; and experiments with physical systems.
Credits: 3.0
Lec-Rec-Lab: (2-0-2)
Semesters Offered: Fall, Spring
Pre-Requisite(s): EE 3160

EE 3290 - Photonic Material, Devices, and Applications
Light wave propagation in optical crystals and fibers, detection, and the creation of light in semiconductors.
Credits: 4.0
Lec-Rec-Lab: (3-0-2)
Semesters Offered: Fall, Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): EE 3131(C) and UN 1015

EE 3901 - Design Fundamentals
The design process; includes team design activities and studies project management, ethics, and professionalism.
Credits: 2.0
Lec-Rec-Lab: (2-0-0)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): EE 3131(C) and UN 1015

EE 4219 - Introduction to Electric Machinery and Drives
Provides a hands on understanding of how electric machines can be used to drive loads with control of speed, torque and position. Topics include basic electromechanics, rotating machinery, dynamic behavior, power electronics and load modeling. Applications include industrial systems, hybrid/electric vehicles and electric power systems.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Pre-Requisite(s): EE 2110 or EE 2112 or EE 3010

EE 4220 - Introduction to Electric Machinery and Drives Laboratory
Provides a thorough understanding of how electric machines can be used to drive loads with control of speed, torque, and position. Topics include basic electromechanics, rotating machinery, dc machines, ac machines, power electronics, and load modeling.
Credits: 1.0
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Spring
Pre-Requisite(s): EE 4219(C)
EE 4221 - Power System Analysis 1
Covers power transmission line parameters and applications, symmetrical components, transformer and load representations, systems faults and protection, and the per unit system.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Pre-Requisite(s): EE 3120 and (EE 2112 or EE 2110)

EE 4222 - Power System Analysis 2
Topics covered include symmetrical components; symmetrical faults; unbalanced faults; generating the bus impedance matrix and using it in fault studies; power system protection; power system operation; power system stability.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Pre-Requisite(s): EE 4221

EE 4226 - Power Engineering Laboratory
A laboratory based course highlighting single phase and three phase power concepts, including: power factor, single and three phase transformer configurations, non-ideal transformers, synchronous machines, renewable energy, power flow and fault simulations, relay settings and relay testing and calibration.
Credits: 1.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Spring, Summer
Restrictions: Permission of instructor required
Pre-Requisite(s): EE 4221 and EE 4222(C)

EE 4227 - Power Electronics
Fundamentals of circuits for electrical energy processing. Covers switching converter principles for dc-dc, ac-dc, and dc-ac power conversion. Other topics include harmonics, pulse-width modulation, feedback control, magnetic components and power semiconductors.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Summer
Pre-Requisite(s): EE 3120 and (EE 3130(C) or EE 3131)

EE 4228 - Power Electronics Lab
Fundamentals of design, construction and control of circuits for electrical energy processing. Covers switching converter principles for dc-dc, ac-dc, and dc-ac power conversion. Other topics include harmonics, pulse-width modulation, feedback control, magnetic components and power semiconductors.
Credits: 1.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Fall
Pre-Requisite(s): EE 4227(C)

EE 4231 - Physical Electronics
Device physics and physical models of the most basic solid-state device structures. Major topics include the terminal characteristics and their physical origin, device design, and device applications.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Pre-Requisite(s): EE 3130 or EE 3131

EE 4232 - Electronic Applications
Study of electronic circuits under small- and large-signal conditions. Typical topics include analysis and design of power and RF amplifiers, feedback circuits, oscillators, timing circuits, and wave-shaping circuits.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Pre-Requisite(s): EE 3130 or EE 3131

EE 4240 - Introduction to MEMS Fundamentals of micromachining and microfabrication techniques, including planar thin-film process technologies, photolithographic techniques, deposition and etching techniques, and the other technologies that are central to MEMS fabrication.
Credits: 4.0
Lec-Rec-Lab: (3-1-0)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior
Pre-Requisite(s): EE 3160

EE 4253 - Real Time Signal Processing Practical implementation of digital signal processing concepts as developed in EE4252. Emphasis on applications of DSP to communications, filter design, speech processing, and radar. Laboratory provides practical experience in the design and implementation of DSP solutions.
Credits: 3.0
Lec-Rec-Lab: (2-0-2)
Semesters Offered: Spring
Pre-Requisite(s): EE 4252

EE 4256 - Fourier Optics
Analysis and modeling of diffraction effects in optical systems, emphasizing frequency-domain analytic and computational approaches. Presents wave propagation, imaging, and optical information processing applications.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Major(s): Electrical Engineering
Pre-Requisite(s): EE 3090 or EE 3140 and EE 3160

EE 4262 - Digital and Non-linear Control
State space based control system design; digital control system design and analysis (Z-transforms, difference equations, and the discrete-time state model); introduction to nonlinear systems (equilibrium states, linearization, phase plane analysis, and describing function analysis); discrete-event controller design (state-transition techniques, relay ladder logic, and Petri nets); and experiments with physical systems.
Credits: 3.0
Lec-Rec-Lab: (2-0-2)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Major(s): Electrical Engineering
Pre-Requisite(s): EE 3261

EE 4271 - VLSI Design
Design of VLSI circuits using CAD tools. Analysis of physical factors affecting performance.
Credits: 4.0
Lec-Rec-Lab: (3-0-2)
Semesters Offered: Fall, Summer
Pre-Requisite(s): EE 3131 and EE 2174

EE 4272 - Computer Networks
Computer network architectures and protocols; design and implementation of data link, network, and transport layer functions. Introduction to the Internet protocol suite (TCP, UDP, IP), domain name service and protocols, file sharing protocols, wireless networks, and network security.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): CS 3411

EE 4290 - Optical Communication
Fundamentals of fiber optics communications, including sources, transmission media, detectors, signal processing, and networking.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Major(s): Electrical Engineering
Pre-Requisite(s): EE 3291

EE 4295 - Introduction to Propulsion Systems for Hybrid Electric Vehicles
Hybrid electric drive vehicle analysis will be developed and applied to examine the operation, integration, and design of powertrain components. Model based simulation and design is applied to determine vehicle performance measures in comparison to vehicle technical specifications. Power flows, losses, energy usage, and drive quality are examined over drive-cycles via application of these tools.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Summer
Restrictions: Must be enrolled in one of the following College(s): College of Engineering; May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): MEEM 2200 or ENG 3200

EE 4296 - Introduction to Propulsion Systems for Hybrid Electric Vehicle Laboratory
Hybrid electric drive vehicles and their powertrain components will be examined from the aspects of safety, testing and analysis, energy conversion, losses, and energy storage, and vehicle technical specifications and vehicle development process. The lab will culminate with vehicle testing to perform power flow and energy analysis during a drive-cycle.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following College(s): College of Engineering; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior
EE 4365 - In-Vehicle Communication Networks
Course focuses on in-vehicle system domains and their requirements, and in-vehicle communication bus Controller Area Network (CAN) and its related physical layers standards. It also covers LIN, FlexRay, and MOST. In-vehicle network examples, components, and tools are presented.
Credits: 3.0
Lec-Rec-Lab: (0-2-3)
Semesters Offered: Fall, Spring
Pre-Requisite(s): EET 1141 or EET 1120 or EET 2111 or EET 3010 or PH 2230

EE 4411 - Engineering Electromagnetics
A mathematically rigorous study of dynamic electromagnetic fields, beginning with Maxwell's equations. Topics include scalar and vector potentials, waves, and radiation.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Pre-Requisite(s): EE 3140

EE 4490 - Laser Systems and Applications
Survey of laser types and analysis of common physical and engineering principles, including energy states, inversion, gain, and broadening mechanism from a quantum mechanical perspective. Laser applications and laser properties are explored in the laboratory portion.
Credits: 4.0
Lec-Rec-Lab: (3-0-2)
Semesters Offered: Spring
Pre-Requisite(s): EE 3140

EE 4495 - Software/Hardware Design of Multimedia Systems
A comprehensive overview of the design and implementation of the hardware and software of a platform for multimedia applications. Topics include system level design methodology, single-instruction multiple data processor (SIMD), virtual platform implementation, development of an SIMD parallel compiler, and real-time operating systems. (RTOS).
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): CS 3411 and EE 4173

EE 4723 - Network Security
Learn fundamental of cryptography and its application to network security. Understand network security threats, security services, and countermeasures. Acquire background knowledge on well known network security protocols. Address open research issues in network security.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Pre-Requisite(s): EE 4272 or CS 4461

EE 4735 - Embedded Systems Engineering
Covers the use of low-power microcontrollers in embedded sensing and control systems. Topics include: hardware-dependent C programming, commercial I/O devices, configuring I/O ports to interface with analog and digital sensors, actuators, transmitters, receivers, mobile robots, and wireless sensor nets.
Credits: 3.0
Lec-Rec-Lab: (2-0-3)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): (CS 1141 or EE 2241) and (EE 3170 or EE 3171 or EE 3173)

EE 4777 - Distributed Additive Manufacturing Using Open-Source 3-D Printing
This course provides an overview of open-source hardware in theory and practice for an introduction to distributed additive manufacturing using open-source 3-D printing. Each student will build a customized RepRap and will learn all hardware and software for maintaining it.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following College(s): College of Engineering; Must be enrolled in one of the following Class(es): Junior, Senior

EE 4800 - Special Topics in Electrical Engineering
Covers specific topics in electrical engineering.
Credits: variable to 4.0; Repeatable to a Max of 6
Semesters Offered: On Demand
Restrictions: Permission of instructor and department required

EE 4805 - Electrical Engineering Project
A project in electrical engineering. An individual student or a group of students complete a mutually-agreed-upon project in consultation with a faculty member.
Credits: variable to 3.0; Repeatable to a Max of 6; Graded Pass/Fail Only
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor and department required

EE 4870 - Special Topics in Computer Engineering
Covers special topics in computer engineering.
Credits: variable to 4.0; Repeatable to a Max of 6
Semesters Offered: On Demand
Restrictions: Permission of instructor and department required

EE 4901 - EE Design Project 1
The first semester of a program of study in which a group of students work on an engineering design project in consultation with a faculty member. (Senior project ready as defined by major substitutes for prerequisites)
Credits: 2.0
Lec-Rec-Lab: (1-0-3)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior
Pre-Requisite(s): EE 3131 or (EE 3130 and EE 3305) and (EE 3901 or EE 4900) and (EE 3170(C) or EE 3171(C) or EE 3173(C))

EE 4910 - EE Design Project 2
The second semester of a program of study in which a group of students work on an engineering design project in consultation with a faculty member. (Senior project ready as defined by major substitutes for prerequisites)
Credits: 2.0
Lec-Rec-Lab: (0-1-3)
Semesters Offered: Spring
Pre-Requisite(s): EE 4901

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**Electrical Engineering Technology**

EET 1120 - Circuits I
Defines resistance, voltage, current, energy, and power, followed by DC network analysis and network theorems. Includes the analysis of transients in capacitive and inductive networks. Lab exercises use electronic test equipment to analyze circuits constructed from schematics.
Credits: 4.0
Lec-Rec-Lab: (0-3-2)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Major(s): Mechanical Engineering Tech, Surveying Engineering, Computer Network & System Admin
Pre-Requisite(s): MA 1031 or MA 1032 or MA 1160 or MA 1161(C) or MA 1135(C)

EET 1411 - Basic Electronics
Introduction to basic electrical principles and devices including DC and AC circuits, diodes, transistors, operational amplifier ICs, power supply regulation, and elements of communication systems.
Credits: 4.0
Lec-Rec-Lab: (0-3-2)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Class(es): Major(s): Mechanical Engineering Tech, Surveying Engineering, Computer Network & System Admin
Pre-Requisite(s): MA 1031 or MA 1032 or MA 1160(C) or MA 1161(C) or MA 1135(C)

EET 2120 - Circuits II
Defines and applies sinusoidal steady-state AC concepts such as impedance, complex power, resonance, and frequency response. Applies basic network analysis tools to AC single phase and balanced three-phase networks, bridge circuits, and filters. AC circuit principles are reinforced by coordinated lab exercises.
Credits: 4.0
Lec-Rec-Lab: (0-3-2)
Semesters Offered: Fall
Pre-Requisite(s): EET 1120 and (MA 1160(C) or MA 1161(C) or MA 1135(C))

EET 2141 - Digital Electronics and Microprocessor Fundamentals
A study of the fundamental components used in digital logic circuits and microcomputer architecture and programming. Topics include: number systems and codes, Boolean algebra, combinational logic circuits, flip-flops, arithmetic circuits, counters and registers, decoders, multiplexers, memory organization, microcomputer addressing modes, stacks and subroutines.
Credits: 4.0
Lec-Rec-Lab: (0-3-2)
Semesters Offered: Fall
Pre-Requisite(s): EET 1120 or EET 1411

EET 2142 - Digital Design and Modeling Using VHDL
Emphasizes the language concepts of digital systems design using VHDL with emphasis on good design practices and writing verification testbenches. Students will gain valuable hands-on experience writing efficient hardware design code and performing simulations using ModelSim.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Spring
Pre-Requisite(s): EET 2141
EET 2220 - Electronic Devices & Circuits
Introduction to solid-state electronic devices and their application. Studies diodes, transistors and operational amplifier ICs. Transistor biasing, temperature stabilization and gain calculations of single and multistage amplifiers. Studies power amplifiers, frequency response, heat sinking and power supply design. Credits: 4.0
Lec-Rec-Lab: (0-3-3)
Semesters Offered: Spring
Pre-Requisite(s): EET 2120

EET 2233 - Electrical Machinery
Fundamental steady-state analysis of DC, AC polyphase and AC single-phase electrical machines as well as transformers. Credits: 4.0
Lec-Rec-Lab: (0-3-3)
Semesters Offered: Fall, Summer
Pre-Requisite(s): EET 1411 or EET 2120(C)

EET 2241 - C++ and Matlab Programming
Introduction to C++ programming and MATLAB for use in solving problems encountered in engineering technology. C++ topics include the basics of syntax and program structure. Focuses on the basic capabilities of MATLAB and its programming environment. Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Major(s): Electrical Eng Tech (BS)
Pre-Requisite(s): EET 2160(C)

EET 2411 - Digital Electronics
Introduction to the fundamentals of the digital electronics that make up microprocessors. Topics include number systems and codes, Boolean algebra, combinational and sequential logic circuits, arithmetic circuits, and digital memory. Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Fall, Summer
Restrictions: Must be enrolled in one of the following Major(s): Computer Network & System Admin
Pre-Requisite(s): EET 1411 and (MA 1031(C) or MA 1032(C) or MA 1160(C) or MA 1161(C) or MA 1135(C))

EET 2413 - Data Communications
Introduction to the fundamentals of basic data communication methods. Topics include data transmission, signal encoding techniques, digital data communication techniques, transmission media, and frequency domain analysis. Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Fall, Summer
Restrictions: Must be enrolled in one of the following Major(s): Electrical Eng Tech (BS), Computer Network & System Admin
Pre-Requisite(s): EET 1411 or EET 1120

EET 3131 - Instrumentation
An investigation of transducers and where they are used. Topics include signal conditioning, sensitivity, linearity, hysteresis, process measurements, and position, motion and force measurements. Exposure to graphical data acquisition tools such as LabVIEW is incorporated. Credits: 3.0
Lec-Rec-Lab: (0-2-3)
Semesters Offered: Spring
Pre-Requisite(s): EET 1411 or EET 2220 or PH 2230 or EE 2110 or EE 3010

EET 3141 - Computer Architecture and Design
Computer system components, instruction set design, hardwired control units, arithmetic algorithms/circuits, floating-point operations, introduction to memory and I/O interfaces. Credits: 4.0
Lec-Rec-Lab: (0-3-3)
Semesters Offered: Fall
Pre-Requisite(s): EET 2241 and EET 2142(C)

EET 3143 - Programmable Logic Devices
Emphasizes the concept of design, simulation and implementation of large scale digital systems which incorporate digital devices at all complexity levels. Credits: 3.0
Lec-Rec-Lab: (0-2-3)
Semesters Offered: Fall, Spring
Pre-Requisite(s): EET 3141

EET 3225 - Special Electronic Devices
An advanced course in the study of linear integrated circuits. Includes op amps, comparators, wave form generators, timers and regulators. Emphasizes practical applications, including the interface of time-continuous measures to the discrete digital world. Credits: 4.0
Lec-Rec-Lab: (0-3-3)
Semesters Offered: Fall
Pre-Requisite(s): EET 2220

EET 3281 - Electrical Project Development and Troubleshooting
Covers soldering, component layout, printed circuit board artwork, troubleshooting, electrical and environmental factors in design as well as an overview of the practical methods used by industry to process projects. The student designs and fabricates a circuit board and assembles a project. Credits: 3.0
Lec-Rec-Lab: (0-1-3)
Semesters Offered: Spring
Pre-Requisite(s): EET 2220

EET 3367 - Communication Systems
Basic course in communication systems. Topics include noise designation and calculation, bandwidth, frequency domain analysis, oscillators, AM/FM analysis, AM/FM transmission and reception, superheterodyne principle, and SSB. Credits: 4.0
Lec-Rec-Lab: (0-3-3)
Semesters Offered: Spring
Pre-Requisite(s): EET 3225

EET 3373 - Introduction to Programmable Controllers
The design of discreet sequential controls using programmable logic controllers (PLCs). Relay logic is used to introduce ladder logic and ladder logic is used to program the PLC. Introduces a structured approach to sequential control design. Data acquisition is introduced using BridgeVIEW software. Credits: 3.0
Lec-Rec-Lab: (0-2-3)
Semesters Offered: Fall
Pre-Requisite(s): EET 1411 or (EET 2120 and EET 2141) or EET 2411 or PH 2230 or EE 2110 or EE 3010 or EE 2112

EET 3390 - Power Systems
A study of the transmission of electrical power from generators to loads, system components and system performance. Covers basics of power systems and their analysis, the per-unit concept, faults on power circuit interrupting, system instrumentation, and automatic protection system. Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): EET 2223

EET 4141 - Microcomputer Interfacing
The design of systems, hardware, and software needed to perform serial and parallel data transmission between microcomputers. Data collection using analog to digital converters, and analog and digital control outputs. Credits: 4.0
Lec-Rec-Lab: (0-3-3)
Semesters Offered: Fall
Pre-Requisite(s): EET 2141 or CS 1121

EET 4142 - Digital Signal Processing Applications
Provides students with knowledge in architecture, instruction set, hardware and software development tools associated with a fixed point general purpose DSP. Includes applications of DSP in control of electric drives and power electronic devices. Credits: 3.0
Lec-Rec-Lab: (0-2-3)
Semesters Offered: Spring
Pre-Requisite(s): EET 3367 and EET 4141

EET 4144 - Real-Time Robotics Systems
Covers the components of a robot system, safety, concepts of a work-cell system, geometry, path control, automation sensors, programming techniques, hardware, and software. Credits: 4.0
Lec-Rec-Lab: (0-3-3)
Semesters Offered: On Demand
Pre-Requisite(s): EET 1411 or EET 2220 or PH 2230 or EE 2110 or EE 3010

EET 4147 - Industrial Robotic Vision Systems and Advanced Teach Pendant Programming
Procedures for setting up, teaching, testing, and modifying robot vision systems widely used in industrial automation. Introduces advanced Teach Pendant Programming to develop complex scenarios for integrating robots into industrial cells. Advanced TPP requires knowledge from prerequisite EET4144. Credits: 4.0
Lec-Rec-Lab: (0-3-2)
Semesters Offered: Fall, Summer
Pre-Requisite(s): EET 4144

EET 4253 - LabVIEW Programming for Data Acquisition
An introduction to graphical programming using LabVIEW. Data acquisition and control programs will be written. Transducer utilization and signal conditioning are studied, including handling of noise. DAQ interfaces will be designed, built, and implemented. Credits: 3.0
Lec-Rec-Lab: (0-2-3)
Semesters Offered: Spring
Pre-Requisite(s): EET 1411 or EET 2220 or EE 2110 or EE 3010 or PH 2230
EET 4311 - Advanced Circuits and Controls
This course considers the modeling, design and implementation of basic and advanced process control strategies. Process modeling and dynamics will be considered using LaPlace transform analysis. Control techniques addressed will include feedback, cascade, feedforward, multivariable and model based methods.
Credits: 4.0
Lec-Rec-Lab: (0-3-3)
Semesters Offered: Fall
Pre-Requisite(s): EET 3131 or EET 4253

EET 4363 - Industrial Communication Protocols
A variety of industrial communication protocols and their importance as the backbone of all industrial components will be presented. Topics include: serial fieldbus protocols such as CAN, Modbus, PROFIBUS, and CC-Link, and industrial ethernet protocols such as Ether-CAT, PROFINET, EtherNet/IP, Sercos III, and CC-Link.
Credits: 3.0
Lec-Rec-Lab: (0-2-1)
Semesters Offered: On Demand
Pre-Requisite(s): EET 2413(C) or EE 3010(C) or EE 3250(C)

EET 4365 - In-Vehicle Communication Networks
Focuses on in-vehicle system domains and their requirements, and in-vehicle communication bus Controller Area Networks (CAN) and their related physical layers standards. It also covers LIN, FlexRay, and MOST. In-vehicle network examples, components, and tools are presented.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Spring, Summer
Pre-Requisite(s): EET 1411 or EET 1120 or EE 2111 or EE 3010 or PH 2230

EET 4367 - Wireless Communications
Topics include television systems, wave propagation, antennas, digital communications, wireless communications systems and standards, wireless communications channels, multiple access schemes, modern wireless technologies, wireless channel impairments and techniques to minimize them.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Spring
Pre-Requisite(s): EET 3367 and MA 2160

EET 4373 - Advanced Programmable Controllers
Using Allen Bradley Micro Logix, SLC500, & PLC-5 programmable controllers, course covers structured programming, Sequential Function Charts, networking, proportional integral differential control, data acquisition and interfacing. The labs will require students to write and troubleshoot complex PLC programs.
Credits: 4.0
Lec-Rec-Lab: (0-2-3)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): EET 3373

EET 4380 - Alternative Energy Applications
An overview of world energy resources and energy consumption trends. Fundamental principles, applications, and viability of alternative energy sources such as wind, solar, and tidal will also be presented.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): EET 4233

EET 4460 - Senior Project I
Capstone course phase I, requiring the application of knowledge gained in lower division courses. Projects are normally team oriented, require weekly progress reports, and culminate with a final report and oral presentation.
Credits: 3.0
Lec-Rec-Lab: (0-0-6)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must not be enrolled in one of the following Class(es): Freshman, Sophomore

EET 4480 - Senior Project II
A capstone course requiring the application of knowledge gained in lower division courses. Projects are normally team oriented, require weekly progress reports, and culminate with a final report and oral presentation.
Credits: 3.0; Repeatable to a Max of 6
Lec-Rec-Lab: (0-0-6)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must not be enrolled in one of the following Class(es): Senior
Pre-Requisite(s): EET 4460

EET 4996 - Special Topics in Electrical Engineering Technology
Selected additional topics of interest in Electrical Engineering Technology based on student and faculty demand and interest. May be a tutorial, seminar, workshop, project, or class study.
Credits: variable to 3.0; Repeatable to a Max of 6
Semesters Offered: On Demand
Restrictions: Permission of instructor required; Must be enrolled in one of the following Major(s): Electrical Eng Tech (BS); Must be enrolled in one of the following Class(es): Senior

Kinesiology & Integrative Physiology

EH 1000 - Introduction to Exercise Science
Introduction to the fields and career opportunities in the exercise sciences.
Credits: 1.0
Lec-Rec-Lab: (1-0-0)
Semesters Offered: Fall

EH 1010 - Introduction to Sports and Fitness Management
Introduction to the fields and career opportunities in sports and fitness management.
Credits: 1.0
Lec-Rec-Lab: (1-0-0)
Semesters Offered: Fall

EH 1500 - Foundations of Kinesiology
Introduces academic subdisciplines of kinesiology - anatomy, motor behavior, biomechanics, physiology, exercise and the environment, sport nutrition and the mind and brain in exercise. Provides the conceptual framework within which the scientific bases for movement during exercise, sport performance, and other forms of physical activity are studied.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring

EH 2050 - Sports and Fitness Leadership
Course is designed to help students succeed in leadership principles, effective communication, team work, and introspection. Students will lead, teach, and collaborate with their peers through different assignments and active participation in class.
Credits: 2.0
Lec-Rec-Lab: (0-0-6)
Semesters Offered: Fall
Pre-Requisite(s): PE 2028

EH 2100 - Principles of Sports Officiating
Theory and practice of officiating various sports common in the community and school setting.
Credits: 2.0
Lec-Rec-Lab: (1-0-2)
Semesters Offered: Fall - Offered alternate years beginning with the 2014-2015 academic year
EH 2470 - Lifeguard First Aid
Lecture, demonstration, and practice of first aid knowledge and skills. Adult, child, and infant CPR skills will be covered as well as AED. Cost of Red Cross certification is not included in the tuition and lab fee. A fee can be by the student to the American Red Cross if certification is desired.
Credits: 1.0
Lec-Rec-Lab: (0-0-1)
Semesters Offered: Spring
Co-Requisite(s): PE 1470

EH 2580 - Water Safety Instructor
Teaching techniques for all levels of swimming, leading to Red Cross certification in WSI. Requires excellent execution of all strokes (Red Cross Level IV). Cost of Red Cross certification is not included in the tuition and lab fee. A fee can be paid by the student to the American Red Cross if certification is desired.
Credits: 1.0
Lec-Rec-Lab: (1-0-0)
Semesters Offered: Spring
Co-Requisite(s): PE 1580

EH 2800 - Health Promotion
This course emphasizes methods in planning, designing, implementing, and improving health/wellness promotion programs. Client motivation, behavior change, and physical activity for special populations will be addressed.
Credits: 2.0
Lec-Rec-Lab: (2-0-0)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): EH 1500

EH 3000 - Master Student Athlete
Read, discuss, and practice study skills, cognitive strategies, goal development, and address contemporary issues problematic in today's college environment.
Credits: 1.0
Lec-Rec-Lab: (1-0-0)
Semesters Offered: Fall
Restrictions: Permission of department required

EH 3010 - Sports Psychology
Overview of psychological principles and their applications to individuals and groups in sport, exercise and/or therapy. For the laboratory portion, students observe and analyze behaviors in a setting of their choice.
Credits: 3.0
Lec-Rec-Lab: (2-0-1)
Semesters Offered: Fall, Spring
Pre-Requisite(s): PSY 2000

EH 3020 - Foundations of Coaching
Practical and relevant information appropriate for beginning and experienced interscholastic coaches.
Credits: 3.0
Lec-Rec-Lab: (2-0-1)
Semesters Offered: Fall, Summer

EH 3030 - Methods of Coaching
Students will demonstrate knowledge of skills, tactics, and strategies in coaching sport teams.
Credits: 2.0
Lec-Rec-Lab: (1-1-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2013-2014 academic year

EH 3050 - Introduction to Athletic Training
Covers first aid, adult CPR, child CPR, and other sport training issues. Students receive appropriate certification cards.
Credits: 3.0
Lec-Rec-Lab: (2-0-1)
Semesters Offered: Fall, Spring

EH 3060 - Sports Medicine Practicum
This course allows students to experience current topics in sports medicine along with learning up-to-date orthopedic injury assessment, treatment, and rehabilitation.
Credits: variable to 2.0; Repeatable to a Max of 2
Semesters Offered: Fall, Spring
Restrictions: Permission of department required

EH 3070 - Sports Administration
Students will learn skills and competencies of sports management including ethics, marketing, law, finance, information, collegiate, olympic, professional, youth, campus recreation programs, parks, career opportunities, foundations, and future directions.
Credits: 2.0
Lec-Rec-Lab: (2-0-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2011-2012 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman

EH 3080 - Facilities & Events Management
Students will learn about managing sports facilities including risk management, administration of personnel, organization, and administrative efficiency.
Credits: 2.0
Lec-Rec-Lab: (2-0-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2015-2016 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman

EH 3100 - Exercise Assessment and Prescriptions
Theory and practical aspects of exercise testing and prescription; topics include testing of strength, endurance, cardiovascular endurance, flexibility, body composition, muscle power, and balance with special considerations for arthritus, osteoporosis, dyslipidemiation, immunology, and metabolic syndrome.
Credits: 3.0
Lec-Rec-Lab: (2-0-2)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): BL 2020 and BL 2021

EH 3690 - Medical First Responder
The first responder course develops emergency medical skills and knowledge that will enable students to assist people who have sustained injury or sudden illness. As the initial level in pre-hospital care, response includes emergency first aid and patient assessment.
Credits: 1.0
Lec-Rec-Lab: (1-0-0)
Semesters Offered: On Demand
Co-Requisite(s): PE 1690

EH 3700 - Lifetime Fitness
To gain a thorough understanding in all areas of personal fitness through functional anatomy, exercise physiology, health and physical fitness, screening and evaluation, nutrition, weight management, exercise prescription and programming considerations, training instruction, and consideration for special populations.
Credits: 3.0
Lec-Rec-Lab: (2-0-2)
Semesters Offered: Summer

EH 3820 - Personal Training
A pragmatic course of both theory and application in setting up a personal training program for individuals. Includes assessment, techniques, planning, safety and legal issues. Leads toward final preparation to earn certification as a personal trainer.
Credits: 2.0
Lec-Rec-Lab: (1-0-1)
Semesters Offered: Spring
Pre-Requisite(s): BL 2010 and BL 2011 and EH 3100

EH 3985 - First Aid/CPR
Lecture, demonstration, and practice of first aid knowledge and skills. Adult, child, and infant CPR skills will be covered as well as AED.
Credits: 1.0
Lec-Rec-Lab: (0-0-2)
Semesters Offered: On Demand

EH 4100 - Coaching Practicum
Students seeking coaching endorsement assist with a sport of their choice. Subject to approval of endorsement advisor, students may assist a head coach in season during student teaching; assist MTU head coach in season; assist head coach in season at public/private school or summer camp.
Credits: 2.0
Lec-Rec-Lab: (0-0-4)
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required
Pre-Requisite(s): EH 3010 and EH 3020

EH 4200 - Sports Nutrition Seminar
Human nutrition as it specifically applies to athletes. Specific needs for proteins, carbohydrates, fats, electrolytes and micronutrients. Use of ergogenic aids is covered. Students will research, write and present orally their findings on nutrition topics.
Credits: 2.0
Lec-Rec-Lab: (0-2-0)
Semesters Offered: Fall, Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): BL 2940

EH 4210 - Exercise Physiology
Focuses on the functional changes brought by acute and chronic exercise sessions. Topics include muscle structure and function, bioenergetics, cardiovascular and respiratory adaptations, exercise training for sport, sport nutrition, ergogenic aids, and other health and fitness topics.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Co-Requisite(s): EH 4211
Pre-Requisite(s): BL 2020 and BL 2021
EH 4211 - Exercise Physiology Laboratory
A companion course to EH4210. Hands-on experience in making physiological measurements as related to exercise. Cardiovascular and respiratory changes during exercise will be monitored. A virtual lab is used to simulate changes in physiological measurements that cannot be performed on live subjects. A student designed laboratory project is required.
Credits: 1.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Fall
Co-Prerequisite(s): EH 4210

EH 4220 - EKG Interpretation
Course is designed for students who are going to pursue future career related to cardiac rehabilitation, physical therapy and students in the Pre-Med program. Students will learn cardiac electrophysiology, the pathophysiology, the diagnosis, and treatment of cardiac arrhythmias, and related cardiovascular diseases. Class will build bridge between basic sciences and human health.
Credits: 2.0
Lec-Rec-Lab: (0-2-0)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Prerequisite(s): BL 2020 and BL 2021

EH 4400 - Motor Learning and Control
Designed for upper level undergraduates or graduates, this course will provide the current theories and concepts involved in the processes of motor skill acquisition and performance from a behavioral perspective.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Pre-Prerequisite(s): EH 1500 and BL 2020

EH 4420 - Motor Development
Designed for upper level undergraduates or graduates, this course will focus on the changes in motor behavior across a life span, and examine the study and practice of fundamental patterns within the context of development theory.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Pre-Prerequisite(s): EH 1500 and BL 2020

EH 4500 - Biomechanics of Human Movement
An in-depth view of the biomechanical properties of the musculoskeletal system. The course provides detailed analyses of the kinetics of human movement, material properties of the component tissues, and dynamic processes of adaptation to stress and strain of the system.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Co-Prerequisite(s): EH 4511
Pre-Prerequisite(s): BL 2020 and EH 1500 and PH 1110 and PH 1111

EH 4510 - Strength and Conditioning
Theory and practice in development and administration of comprehensive strength and conditioning programs for both the athlete and individual of any level. Includes knowledge, safety concerns and skill techniques necessary for teaching and administering at any strength and conditioning facility.
Credits: 3.0
Lec-Rec-Lab: (2-1-0)
Semesters Offered: On Demand
Pre-Prerequisite(s): BL 2020 and BL 2021

EH 4511 - Biomechanics of Human Movement Laboratory
A companion course to EH4500. Hands-on experience, including data collection, analysis, and interpretation using various equipment in biomechanics.
Credits: 1.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Fall
Co-Prerequisite(s): EH 4500
Pre-Prerequisite(s): BL 2020 and EH 1500 and PH 1110 and PH 1111

EH 4600 - Sports and Fitness Promotions
Development and implementation of marketing plans for sports and fitness businesses. Topics include marketing of sporting events and fitness programs, use of traditional media for promotion, web-based advertising (new media), and business branding.
Credits: 2.0
Lec-Rec-Lab: (2-0-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2011-2012 academic year
Pre-Prerequisite(s): MKT 3000

EH 4620 - Legal Issues in Sports and Fitness Management
Review of legal issues that apply to sport and fitness organizations such as liability, risk management, facility concerns, and labor laws. Basic components of the U.S. legal system and guidelines, and rules of the National Collegiate Athletic Association will be covered.
Credits: 2.0
Lec-Rec-Lab: (2-0-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2012-2013 academic year

EH 4700 - Physical Therapy Seminar
Seminar for students who are interested in physical therapy profession. Course will include self-directed learning and group work. Topics may include evidence based medicine, literature review writing and evaluation, healthcare reimbursement, clinical decision making, health screenings, and other current topics.
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2014-2015 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Prerequisite(s): BL 2020 and BL 2021

EH 4710 - Stress Physiology
This course focuses on stress physiology in humans. Topics include neural and hormonal responses to mental stress, interactions between physical and mental stress, bidirectional relations between stress and disease, and health disparities associated with stress.
Credits: 2.0
Lec-Rec-Lab: (1-1-0)
Semesters Offered: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Prerequisite(s): BL 2020 and BL 2021

EH 4711 - Sports Medicine and Ethics
Examines ethical issues in sports medicine. Topics might include the ethical responsibilities and conflicts of interest for team physicians, research on athletes, sport-related concussions, and doping. Philosophical ethical foundations, and professional ethical codes for sports medicine will be studied.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Prerequisite(s): BL 2020 and BL 2021

EH 4720 - Sleep and Circadian Physiology
This course focuses on the role of sleep and circadian rhythm on physiological control systems. Topics include the sleep-wake cycle, role of sleep and circadian clock on cardiovascular and respiratory control, overview and treatment strategies for common sleep disorders, and techniques in sleep medicine research.
Credits: 3.0
Lec-Rec-Lab: (2-1-0)
Semesters Offered: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Prerequisite(s): BL 2020 and BL 2021

EH 4730 - Neuroendocrine Physiology
This course will focus on understanding how the neural and endocrine system are regulated under both normal physiological conditions and pathophysiological states.
Credits: 3.0
Lec-Rec-Lab: (2-1-0)
Semesters Offered: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Prerequisite(s): BL 2020 and BL 2021

EH 4760 - Computational Biomechanics
This course provides an introduction to the application of computer simulation to solve some fundamental problems in biomechanics and bioengineering. Musculoskeletal mechanics, joint mechanics, and inter-subject variability will be discussed.
Credits: 3.0
Lec-Rec-Lab: (2-1-0)
Semesters Offered: On Demand
Pre-Prerequisite(s): EH 4500

EH 4770 - Specificity of Exercise Assessment & Prescription
Peer-reviewed literature will be utilized to understand the sport-specific needs of athletes in regard to how they are tested and trained. Laboratory sessions will cover measurement techniques such as expired air analysis, blood lactate assessment, and surface electromyography.
Credits: 3.0
Lec-Rec-Lab: (2-1-0)
Semesters Offered: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Prerequisite(s): EH 3100
EH 4800 - Internship in Sports and Fitness Management
Empirical experiences in an approved internship site. Provides practical experience in one or more work settings, assisting the upper level student in making an appropriate career choice. Internships must be approved by the department internship coordinator and work 50 hours for each credit earned.
Credits: variable to 12.0; Repeatable to a Max of 12
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required; Must be enrolled in one of the following Major(s): Sports and Fitness Management; May not be enrolled in one of the following Class(es): Freshman, Sophomore

EH 4850 - Kinesiology Senior Capstone
This culminating discipline-based course will be taken during the final year of study to prepare students to enter the workforce in sport/fitness health, or prepare them for graduate education. Topics include professional development, communication, problem solving, portfolio development, and time management.
Credits: 1.0
Lec-Rec-Lab: (1-0-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Major(s): Sports and Fitness Management, Exercise Science; Must be enrolled in one of the following Class(es): Senior

EH 4900 - Internship in Exercise Science
Practical and didactic training in Exercise Science in an approved internship site. Provides experience in a variety of exercise science or medical settings. Internships must be approved by the department internship coordinator and work 50 hours for each credit earned.
Credits: variable to 9.0; Repeatable to a Max of 9
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required; Must be enrolled in one of the following Major(s): Exercise Science; May not be enrolled in one of the following Class(es): Freshman, Sophomore

EH 4950 - Special Topics in Physical Activity
Only open to Health and Physical Education majors. Departmental approval necessary.
Credits: variable to 9.0; Repeatable to a Max of 9
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required; Must be enrolled in one of the following Major(s): Exercise Science; May not be enrolled in one of the following Class(es): Freshman, Sophomore

EH 4990 - Special Topics in Exercise Science
Examination of current topics in the field of exercise science. Literature and research topics are addressed.
Credits: variable to 9.0; Repeatable to a Max of 9
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required; Must be enrolled in one of the following Major(s): Sports and Fitness Management, Exercise Science; May not be enrolled in one of the following Class(es): Freshman, Sophomore

EH 4995 - Research in Kinesiology
A literature and laboratory research experience in kinesiology that culminates in a written report or oral presentation of the work performed.
Credits: variable to 3.0; Repeatable to a Max of 9
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required

Engineering Fundamentals

ENG 1001 - Engineering Problem Solving
Introduction to the engineering problem solving method and to modern tools used to solve problems.
Credits: 2.0
Lec-Rec-Lab: (0-0-4)
Semesters Offered: Fall
Pre-Requisite(s): (MA 1031(C) or MA 1032(C)) and (Spatial Visualization Score >= 19 or ENG 1002(C))

ENG 1002 - Introduction to 3-D Spatial Visualization
Intended for first-year engineering students with a demonstrated need for the development of 3-D spatial visualization skills. Topics include isometric sketching, orthographic projection, object transformations, 3-D coordinate systems, patterns folding to 3-D objects, and cross sections of solids.
Credits: 1.0
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring
Restrictions: Permission of department required

ENG 1003 - Introduction to Computer Aided Drafting
Fundamentals of creating engineering drawings with modern CAD software. Topics include basic geometric construction, drawing modification, dimensioning, and working with layers. Designed for students with no CAD experience.
Credits: 1.0
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): ENG 1002 or ENG 1100 or ENG 1101

ENG 1100 - Engineering Analysis
An introduction to the engineering profession. Focuses on engineering analysis, computational skills, and communication skills.
Credits: 2.0
Lec-Rec-Lab: (0-0-4)
Semesters Offered: Spring
Pre-Requisite(s): ENG 1001 and (MA 1160(C) or MA 1161(C)) and (Spatial Visualization Score >= 19 or ENG 1002(C))

ENG 1101 - Engineering Analysis and Problem Solving
An introduction to the engineering profession and to its various disciplines. Focuses on developing problem-solving skills, computational skills, and communication skills. Through active, collaborative work, students work on teams to apply the engineering problem-solving method to "real-world" problems.
Credits: 3.0
Lec-Rec-Lab: (0-0-5)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): (MA 1160(C) or MA 1161(C) or MA 2160(C)) and (Spatial Visualization Score >= 19 or ENG 1002(C))

ENG 1102 - Engineering Modeling and Design
Continuation of ENG 1101. Introduction to the engineering design process with an emphasis on graphics and documentation. Focuses on engineering problem solving in the context of the design process.
Credits: 3.0
Lec-Rec-Lab: (0-0-5)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): (MA 1160 or MA 1161 or MA 2160(C)) and (ENG 1001 or (ENG 1001 and ENG 1100)) and (Spatial Visualization Score >= 19 or ENG 1002)

ENG 1990 - Special Topics in Engineering
Engineering topics of interest to students and faculty that are not normally covered in the existing courses.
Credits: variable to 5.0; Repeatable to a Max of 6
Semesters Offered: On Demand
Restrictions: Permission of instructor required

ENG 2120 - Statics-Strength of Materials
The composition and resolution of forces and force systems, principles of equilibrium applied to various bodies, simple structures, friction, and 2nd moments of area. Intro to the mechanical behavior of materials, including calculation of stresses, strains, and deformations due to axial, torsional, and flexural loading. Uses MATLAB.
Credits: 4.0
Lec-Rec-Lab: (0-4-0)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Major(s): Mechanical Engineering, Civil Engineering
Pre-Requisite(s): MA 2160 and PH 2100 and ENG 1102

ENG 2990 - Special Topics in Engineering
Engineering topics of interest to students and faculty that are not normally covered in the existing courses.
Credits: variable to 5.0; Repeatable to a Max of 6
Semesters Offered: On Demand
Restrictions: Permission of instructor required

ENG 3200 - Thermodynamics/Fluid Mechanics
Provides engineering students with a unified understanding of the fundamental conservation laws and property accounting applied to thermodynamic and fluid dynamic systems. Topics will include but are not limited to: ideal gas behavior; heat, work, and energy; 1st and 2nd laws of thermodynamics; heat pumps; cycles; hydrostatics; Bernoulli; pipe flow and loss; and lift and drag. Uses MATLAB.
Credits: 4.0
Lec-Rec-Lab: (0-4-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): MA 2160 and CH 1112 or (CH 1150 and CH 1151) and PH 2100 and ENG 1102

ENG 3530 - Undergraduate Colloquium in Sustainability
Readings and speakers are used to teach concepts of sustainable development and global sustainability. Specific topics are derived from the industrialized and developing world.
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Class(es): Graduate
ENT 1960 - Enterprise Orientation-Spring
An orientation for students to their specific enterprise. Covers enterprise specific topics but should also include organizational structure, past, present and future projects and their results.
Credits: 1.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Fall, Spring, Summer

ENT 2950 - Enterprise Project Work I
Interdisciplinary teams work as part of an enterprise to address real-world design projects or problems. Second-year students are responsible for achieving some prescribed objectives, as defined by their Enterprise team.
Credits: 1.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Fall, Spring, Summer
Restrictions: May not be enrolled in one of the following Class(es): Freshman

ENT 2960 - Enterprise Project Work II
Interdisciplinary teams work as part of an enterprise to address real-world design projects or problems. Second-year students are responsible for achieving some prescribed objectives, as defined by their Enterprise team.
Credits: 1.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Fall, Spring, Summer
Restrictions: May not be enrolled in one of the following Class(es): Freshman

ENT 2961 - Teaming in the Enterprise
Develops group problem-solving skills. Stresses interpersonal skills and skill assessment, communication, group process and teamwork, and action planning. Uses active, hands-on learning.
Credits: 2.0
Lec-Rec-Lab: (0-1-2)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Class(es): Freshman

ENT 2962 - Communication Contexts
An introduction to the demands of technical and professional communication in workplace settings, through analyzing project design team experiences.
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): UN 1002 or UN 1003

ENT 3950 - Enterprise Project Work III
Interdisciplinary teams work as part of an enterprise to address real-world design projects or problems. Third-year students will practice designing approaches to solve problems and develop procedures to achieve specified project objectives.
Credits: 1.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior

ENT 3953 - Lean Launchpad I
Students will learn how to bring ideas from concept to market by rapidly developing and testing them through customer feedback. By learning how to search for the unmet needs of customers, students will develop strong product ideas and business models.
Credits: 2.0
Lec-Rec-Lab: (0-1-2)
Semesters Offered: Fall, Spring
Restrictions: Permission of instructor required

ENT 3954 - Enterprise Market Principles
Examines the fundamental principles of marketing in the six stages of product life cycle (opportunity identification, product development, introduction, growth, maturity, and decline).
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior

ENT 3956 - Industrial Health and Safety
Instruction of health and safety in engineering practice. Integrates the study of health and safety regulations, risks, and potential for improvement. Also covers the tremendous financial, ethical, and public relations implications of disregarding this critical aspect of engineering.
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior

ENT 3958 - Ethics in Engineering Design and Implementation
The focus of this course is on ethical considerations in the engineering design and implementation process. Basic ethical analysis tools will be explored through various exercises. Students will analyze and present live engineering ethics case studies.
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): ENG 1101 or (ENG 1001 and ENG 1100)

ENT 3959 - Fundamentals of Six Sigma I
This course introduces tools used for design and process improvement development including lean manufacturing and six sigma.
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior

ENT 3960 - Enterprise Project Work IV
Interdisciplinary teams work as part of an enterprise to address real-world design projects or problems. Third-year students practice designing approaches to solve problems and develop procedures to achieve specified project objectives.
Credits: 1.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior
ENT 3961 - Enterprise Strategic Leadership
This 1-credit module focuses on exploring research findings about leadership, the practice of leadership, and providing skill assessment and development opportunities. Topics include leadership traits, behaviors, theories, and leadership of change. Combines a variety of teaching methods, including self-assessment, cases, discussion, experiential exercises, role-playing, videotaping.
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Spring
Pre-Requisite(s): ENT 2961 and (EC 2001 or PSY 2000 or SS 2100 or SS 2200 or SS 2400 or SS 2500 or SS 2501 or SS 2502 or SS 2503 or SS 2504 or SS 2505 or SS 2600 or SS 2700)

ENT 3962 - Communication Strategies
Drawing on the broad understanding of workplace communication developed in ENG2962, students will learn and practice strategies for effective oral and written communications in technical and professional settings. Emphasis is on audience adaptation of technical information and on achieving clearly specified purposes.
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior

ENT 3963 - Technology Commercialization
Presents fundamentals important to moving technology from idea to market. Topics covered include technology assessment and evaluation, intellectual property protection, competitive analysis, legal agreements and transfers of rights, market analysis, marketing, business planning, development financing, and company formation.
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior

ENT 3964 - Project Management
Project definition, developing a work breakdown structure, responsibility assignment and milestone development. Covers techniques for project scheduling and practical application of Gantt and PERT/CPM charts; resource management and application of critical chain method; project budgeting and cost estimation; project monitoring, control, evaluation, and termination; and project team, their structure, and interactions.
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior

ENT 3966 - Design for Manufacturing
This course supplements courses that address "design for function." Products "designed for manufacturing" are lower cost, higher quality, and have a shorter time to market. The course describes how the capabilities and limitations of common manufacturing processes translate into qualitative design guidelines. Topics include design for casting, forging, sheet metal forming, machining, plastics and assembly.
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): ENG 1102

ENT 3967 - Six Sigma II
This course builds upon ENT3959 (Six Sigma I) to further develop six sigma skills.
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman

ENT 3970 - Enterprise Special Topics
For the development of new, junior-level instructional modules in support of the enterprise.
Credits: 1.0; May be repeated
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior

ENT 3971 - Seven Habits of Highly Effective People
Focuses on personal and professional effectiveness through greater productivity, increased influence in key relationships, stronger team unity and complete life balance. This course will explore these areas through interactive exercises, case studies, videos, and sharing of experiences.
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior

ENT 3974 - Fuel Cell Fundamentals
This course provides an introduction to fuel cells and fuel cell systems. Topics include an overview of fuel cell construction, fuel cell chemistry, fuel cell losses and efficiency, and integrating fuel cells onto vehicles.
Credits: 1.0
Lec-Rec-Lab: (1-0-0)
Semesters Offered: Fall
Pre-Requisite(s): CH 1112 or (CH 1150 and CH 1151)

ENT 3976 - Personal Brand Management
Principles of personal brand management that athletes, entertainers, and successful companies and business leaders employ. Intended to develop the entrepreneurial spirit while cultivating integrity-based leadership skills and enabling students to distinguish and package their skills and abilities in a professional manner. The brand "YOU" life philosophy focuses on planning, time-management, interpersonal skills and communication, and mission statement development, marketing and planning.
Credits: 1.0
Lec-Rec-Lab: (1-0-0)

ENT 3980 - Pre-Capstone Enterprise Project Work
Interdisciplinary teams work as part of an enterprise to address real-world design projects or problems. This course is to be taken by third-year or fourth-year enterprise students who have completed the junior-level project work, but are not approved as capstone ready by their department.
Credits: 1.0; Repeatable to a Max of 2
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Fall, Spring
Restrictions: Permission of instructor required; May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): ENT 3950 and ENT 3960

ENT 4900 - Senior Enterprise Project Work V Non-Capstone
Interdisciplinary teams work as part of an enterprise to address real-world projects or problems of significance to industry, government and communities. Fourth-year students gain experience in defining project objectives and planning strategies to achieve these objectives, and leading teams to accomplish project goals. This course is for students who are not participating in Enterprise to fulfill their capstone requirements.
Credits: 2.0
Lec-Rec-Lab: (0-0-6)
Semesters Offered: Fall, Spring, Summer
Restrictions: May not be enrolled in one of the following College(s): College of Engineering; Must be enrolled in one of the following Class(es): Senior

ENT 4910 - Senior Enterprise Project Work VI Non-Capstone
Interdisciplinary teams work as part of an enterprise to address real-world projects or problems of significance to industry, government and communities. Fourth-year students gain experience in defining project objectives and planning strategies to achieve these objectives, and leading teams to accomplish project goals. This course is for students who are not participating in Enterprise to fulfill their capstone requirements.
Credits: 2.0
Lec-Rec-Lab: (0-0-6)
Semesters Offered: Fall, Spring, Summer
Restrictions: May not be enrolled in one of the following College(s): College of Engineering; Must be enrolled in one of the following Class(es): Senior

ENT 4950 - Enterprise Project Work V Capstone
Interdisciplinary teams work as part of an enterprise to address real-world design projects or problems. Fourth-year students gain experience in defining project objectives, planning strategies to achieve these objectives, and leading technical teams to accomplish project goals. Must be Senior Project ready as defined by major.
Credits: 2.0
Lec-Rec-Lab: (0-0-6)
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required; Must be enrolled in one of the following Major(s): Civil Engineering, Chemical Engineering, Computer Engineering, Electrical Engineering, Environmental Engineering, Mechanical Engineering, Materials Science and Engg, Software Engineering, Construction Management, Computer Network & System Admin, Electrical Eng Tech (BS), Mechanical Engineering Tech, Surveying Engineering, Biomedical Engineering; Must be enrolled in one of the following Class(es): Senior
Pre-Requisite(s): (BE 3500(C) and BE 3600 and BE 3750 or MEEM 4180) or (CE 3620 or CE 3810 and CE 3331) or CM 4355(C) or (CS 4710 or CS 4711 or CS 4712 or EE 3151 or (EE 3150 and EE 3305) and (EE 4900 or EE 3901) and (EE 3171(C) or EE 3173(C) or EE 3175(C)) or (MEEM 3900(C) and MEEM 3900) or (MY 3110 and MY 3200 and MY 3210 and MY 3300 and MY 3410)
ENVE 1501 - Experiences in Environmental Engineering
Introduction to the mechanics, dynamics and concepts of the financial budgeting process. Applications of financial concepts is emphasized through the development of basic business plans. Topics and activities include budget preparation, performance assessment, and financial evaluation of projects.
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Major(s): Business Administration; Must be enrolled in one of the following Class(es): Junior, Senior

ENVE 4501 - Environmental Engineering
Application of fundamental chemical, biological, and physical principles of environmental engineering to design and operation of systems used for water and wastewater treatment, solid waste management, air pollution control, and analysis of quality of surface water, air, and groundwater.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): MA 2160 and CH 1112 or (CH 1150 and CH 1151)

ENVE 4502 - Wastewater Treatment Principles and Design
Principles of physical, chemical, and biological processes employed in wastewater treatment. Design of selected individual units within wastewater treatment systems.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Pre-Requisite(s): ENVE 3501 or ENVE 3503 and ENVE 3502 and ENG 3200

ENVE 4503 - Drinking Water Treatment Principles and Design
Provides an overview of the principles and design of municipal water treatment practices. Understand the physical and chemical processes employed in water treatment. Design individual unit processes with a view toward integration into complete treatment systems.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Pre-Requisite(s): ENVE 3501 or ENVE 3503

ENVE 4504 - Air Quality Engineering and Science
Overview of air quality regulation in the U.S. and world, including basic concepts of atmospheric chemistry and transport; fugitive, point, and area emissions; principles and tradeoffs of operation and design of air pollution control systems; and application of air quality models.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): ENVE 3501 or ENVE 3503

ENVE 4505 - Surface Water Quality Engineering
Develops the scientific basis for water quality management in lakes and rivers. Considers the origin, behavior, and fate of nutrients and toxic substances. Introduces engineered approaches for lake management, including mass balance modeling. Presents techniques for water quality restoration and the legal framework supporting pollution control.
Credits: 3.0
Lec-Rec-Lab: (0-2-3)
Semesters Offered: Fall
Pre-Requisite(s): ENVE 3501 or ENVE 3503

ENVE 4506 - Application of Sustainability Principles to Engineering Practice
Study of sustainability, federal and state regulations and policies that govern solid and hazardous waste management, environmental risk of toxic chemicals, life cycle assessment, and green engineering.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): ENVE 3501 or ENVE 3503

ENVE 4507 - Water Distribution and Wastewater Collection Design
Application of basic principles in civil and environmental engineering to the analysis and design of water distribution systems, wastewater collection systems, and their appurtenances.
Credits: 3.0
Lec-Rec-Lab: (2-0-1)
Semesters Offered: Spring
Pre-Requisite(s): (ENVE 3501 or ENVE 3503) and CE 3620

ENVE 4509 - Environmental Process & Simulation
Provides a rigorous hands-on introduction to process control, laboratory and pilot-plant experimentation focused on physical, chemical and biological treatment systems used in environmental engineering.
Credits: 2.0
Lec-Rec-Lab: (0-0-5)
Semesters Offered: Spring
Pre-Requisite(s): (ENVE 3501 or ENVE 3503) and ENG 3200 and (ENVE 4502 and ENVE 4503) or ENVE 4508
ENVE 4510 - Baccalaureate Thesis
Independent baccalaureate research project performed under the supervision of one or more faculty.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Restrictions: Permission of instructor required; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

ENVE 4511 - Solid and Hazardous Waste Engineering
Characterization, treatment, separation, and disposal of solid and hazardous wastes. Science and engineering for the management of solid and hazardous waste problems. Technologies discussed include incineration, landfilling, vapor extraction, soil washing, and bioremediation.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Pre-Requisite(s): ENVE 3501 or ENVE 3503

ENVE 4515 - Atmospheric Chemistry
Study of the photochemical processes governing the composition of the troposphere and stratosphere, with application to air pollution and climate change. Covers radical chain reaction cycles, heterogeneous chemistry, atmospheric radiative transfer, and measurement techniques for atmospheric gases.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Class(es): Senior
Pre-Requisite(s): ENVE 4505(C) and ENVE 4505(C)

ENVE 4518 - Aquatic Biogeochemistry
Covers interactions among chemical, biological, and physical processes within aquatic ecosystems as well as role of aquatic ecosystems in global biogeochemistry. Modeling as an integrative tool is stressed.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2014-2015 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): ENVE 4501(C) and ENVE 4505(C)

ENVE 4528 - Global Biogeochemistry
This course gives an overview of important biogeochemical processes occurring in land, air, and water. An emphasis is put on modeling as an integrating tool.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2015-2016 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): ENVE 4501(C)

ENVE 4930 - Environmental Engineering Independent Study
Approved research or design project in environmental engineering, originating with an individual student or assigned by the instructor.
Credits: variable to 3.0; Repeatable to a Max of 3
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required; May not be enrolled in one of the following Class(es): Freshman, Sophomore

ENVE 4990 - Special Topics in Environmental Engineering
Topics of special interest in environmental engineering.
Credits: variable to 3.0; Repeatable to a Max of 9
Semesters Offered: Fall, Spring, Summer

ESL 0211 - High Beginner Vocabulary
For students of English as a second language; not for native speakers of English. Emphasis is on vocabulary acquisition, word form, and morpheme recognition.
Credits: 1.0; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-3)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0220 - High Beginning Writing
For students of English as a second language; not for native speakers of English. Students work collaboratively on writing tasks of various genres through multiple drafts emphasizing structural organization of sentences and paragraphs, and syntactical accuracy.
Credits: 3.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-2-3)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0230 - High Beginner Listening and Speaking
For students of English as a second language, not for native speakers of English. Emphasis on developing oral fluency, conversation, listening strategies, and presentation skills on familiar topics.
Credits: 3.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-2-3)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0240 - High Beginner Grammar
For students of English as a second language; not for native speakers of English. Students receive explicit instruction and form-focused activities to develop mechanics and syntactical accuracy emphasizing various simple, complex, and compound structures, verb forms, and other grammatical elements.
Credits: 1.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-3)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0250 - Beginning Special Topics
For students of English as a second language; not for native speakers of English. Concentrated study of a specific area of ESL. Example: English for computer users.
Credits: variable to 6.0; May be repeated; Graded Pass/Fail Only
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0310 - Intermediate Reading I
For students of English as a second language, not for native speakers of English. Emphasis is on comprehension of main ideas and structural details, critical-thinking skills and class discussion. Students learn to take notes, outline and summarize.
Credits: 3.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-2-3)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0311 - Intermediate Vocabulary I
For students of English as a second language; not for native English speakers. The emphasis is on vocabulary acquisition for academic study. Students will learn techniques for understanding vocabulary words from context; analyze lexical roots, prefixes and suffixes; and become familiar with word association mapping and idiomatic expressions.
Credits: 1.0; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Fall, Spring, Summer
ESL 0320 - Intermediate Writing I  
For students of English as a second language, not for native speakers of English. Students work collaboratively on writing tasks of various genres through multiple drafts; emphasizes structural organization, thesis development and syntactical accuracy.  
Credits: 3.0; May be repeated; Graded Pass/Fail Only  
Lec-Rec-Lab: (0-2-3)  
Semesters Offered: Fall, Spring, Summer  
Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0330 - Intermediate Listening and Speaking I  
For students of English as a second language; not for native speakers of English. Emphasis is on developing oral fluency, skills needed for group work, academic listening strategies and academic presentation skills on familiar, informative topics.  
Credits: 3.0; May be repeated; Graded Pass/Fail Only  
Lec-Rec-Lab: (0-2-3)  
Semesters Offered: Fall, Spring, Summer  
Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0331 - Intermediate Pronunciation I  
For students of English as a second language, not native speakers of English. Emphasis on prosodic elements of second language speech. Focus on identifying features of speech. Time is divided between classroom instruction and lab.  
Credits: 1.0; Graded Pass/Fail Only  
Lec-Rec-Lab: (0-0-3)  
Semesters Offered: Fall, Spring, Summer  
Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0340 - Intermediate Communicative Grammar  
For students of English as a second language; not for native speakers of English. Using explicit instruction and form-focused activities to develop students' syntactical accuracy; emphasizes various simple, complex and compound structures, verb forms and other grammatical elements.  
Credits: 1.0; May be repeated; Graded Pass/Fail Only  
Lec-Rec-Lab: (0-0-3)  
Semesters Offered: Fall, Spring, Summer  
Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0350 - Intermediate Reading II  
For speakers of English as a second language; not for native speakers of English. This is an intermediate reading course for academically oriented ESL students. This course is designed to further develop effective reading strategies for adapted academic texts of varying lengths.  
Credits: 3.0; Graded Pass/Fail Only  
Lec-Rec-Lab: (0-2-3)  
Semesters Offered: Fall, Spring, Summer  
Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0351 - Intermediate Vocabulary II  
For students of English a second language, not for native English speakers. Further emphasis on vocabulary acquisition but with more range and depth than in Intermediate/Vocabulary I. Demonstrate understanding of figurative language, word relationships, and nuances in word meanings. Students will improve their ability to understand and correctly use academic vocabulary that is technical and precise, and meant to convey specific ideas, often with reduced context.  
Credits: 1.0; Graded Pass/Fail Only  
Lec-Rec-Lab: (0-0-3)  
Semesters Offered: Fall, Spring, Summer  
Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0360 - Intermediate Writing II  
For students of English as a second language, not for native speakers of English. Students work collaboratively on writing tasks of various genres through multiple drafts; further development on structural organization, thesis development and syntactical accuracy.  
Credits: 3.0; Graded Pass/Fail Only  
Lec-Rec-Lab: (0-2-3)  
Semesters Offered: Fall, Spring, Summer  
Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0370 - Intermediate Listening and Speaking II  
For students of English as a second language; not for native speakers of English. Further development of oral fluency, skills needed for group work, academic listening strategies, and academic presentation skills on familiar, informative topics.  
Credits: 3.0; Graded Pass/Fail Only  
Lec-Rec-Lab: (0-2-3)  
Semesters Offered: Fall, Spring, Summer  
Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0371 - Intermediate Pronunciation II  
For students of English as a second language, not native speakers of English. Emphasis on identifying and anticipating features of speech. Time is divided between classroom instruction and lab.  
Credits: 1.0; Graded Pass/Fail Only  
Lec-Rec-Lab: (0-0-3)  
Semesters Offered: Fall, Spring, Summer  
Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0380 - Intermediate Communicative Grammar II  
For students of English as a second language, not for native speakers of English. Using explicit instruction and form-focused activities to develop students' syntactical accuracy; further developments on various simple, complex and compound structures, verb forms and other grammatical elements.  
Credits: 1.0; Graded Pass/Fail Only  
Lec-Rec-Lab: (0-0-3)  
Semesters Offered: Fall, Spring, Summer  
Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0390 - Intermediate Special Topics  
For students of English as a second language, not for native speakers of English. Concentrated study of a specific area of ESL in greater depth than in other courses. Examples: English for computer users, idioms. Contact Director of ESL Programs.  
Credits: variable to 6.0; May be repeated; Graded Pass/Fail Only  
Semesters Offered: On Demand  
Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0399 - Intermediate Independent Study  
For students of English as a second language, not for native speakers of English. Selected areas in ESL based on interest and need of student. Interested students should contact the Director of English as a Second Language Programs.  
Credits: variable to 6.0; May be repeated; Graded Pass/Fail Only  
Semesters Offered: On Demand  
Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0410 - Advanced Reading I  
For students of English as a second language, not for native speakers of English. Emphasis is on preparing students for academic study through the development of effective reading strategies, note-taking, inferencing, summarizing, critical thinking and discussion.  
Credits: 3.0; May be repeated; Graded Pass/Fail Only  
Lec-Rec-Lab: (0-2-3)  
Semesters Offered: Fall, Spring, Summer  
Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0411 - Advanced Vocabulary I  
For students of English as a second language, not for native speakers of English. Emphasis is on helping students increase their command of idiomatic English and academic vocabulary in daily and academic situations with attention given to correct pronunciation. Additional practice with the Academic Word List (AWL) will include short writing assignments.  
Credits: 1.0; Graded Pass/Fail Only  
Lec-Rec-Lab: (0-0-3)  
Semesters Offered: Fall, Spring, Summer  
Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0412 - Advanced English for Business  
This course is designed for students of English as a second language, not for native speakers of English. Emphasis is on acquiring vocabulary necessary for academic study of courses required in business majors.  
Credits: 1.0; May be repeated; Graded Pass/Fail Only  
Lec-Rec-Lab: (0-0-3)  
Semesters Offered: Fall, Spring  
Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0413 - Advanced English for Engineering  
This course is designed for students of English as a second language, not for native speakers of English. Emphasis is on acquiring vocabulary necessary for academic study of courses required in engineering majors.  
Credits: 1.0; May be repeated; Graded Pass/Fail Only  
Lec-Rec-Lab: (0-0-3)  
Semesters Offered: Fall, Spring  
Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language
ESL 0414 - Advanced English for Math
This course is designed for students of English as a second language, not for native speakers of English. Emphasis is on acquiring vocabulary necessary for academic study of mathematical courses.
Credits: 1.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0415 - Advanced English for Science
This course is designed for students of English as a second language, not for native speakers of English. Emphasis is on acquiring vocabulary necessary for academic study of courses required in biological science majors.
Credits: 1.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0420 - Advanced Writing I
For students of English as a second language, not for native speakers of English. Students work collaboratively on writing tasks of various genres through multiple drafts; emphasizes coherence and unity, source use and documentation and language formality.
Credits: 3.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-2-3)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0430 - Advanced Listening and Speaking I
For students of English as a second language; not for native speakers of English. Emphasis is on developing oral fluency academic listening strategies, argument development, skills needed for group work and academic presentation skills with a focus on persuasive speaking.
Credits: 3.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-2-3)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0431 - Advanced Pronunciation I
For students of English as a second language, not native speakers of English. Emphasis on prosodic elements of second language speech. Focus on anticipating features of speech. Time is divided between classroom instruction and lab.
Credits: 1.0; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0440 - Advanced Communicative Grammar I
For students of English as a second language; not for native speakers of English. Using explicit instruction, and form-focused activities to develop students' error analysis skills; emphasizes correcting sentence constructions and connections, verb consistency and other common errors.
Credits: 1.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0450 - Advanced Reading II
For students of English as a second language, not for native speakers of English. Emphasis is on preparing students for academic study through the development of effective reading strategies, note-taking, inferring, summarizing, critical thinking and discussion in academic settings using slightly adapted academic texts.
Credits: 3.0; Graded Pass/Fail Only
Lec-Rec-Lab: (0-2-3)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0451 - Advanced Vocabulary II
For students of English as a second language, not for native speakers of English. Emphasis is on mastering the words and phrases that are specific to academic writing, speaking and research, as well as everyday idioms, expressions, and abbreviations. Predicting the pronunciation pattern of new words and phrases; lexical bundles and collocation usage will be also covered.
Credits: 1.0; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0460 - Advanced Writing II
For students of English as a second language, not for native speakers of English. Students work collaboratively on writing tasks of various genres through multiple drafts; further development on coherence and unity, source use and documentation and language formality.
Credits: 3.0; Graded Pass/Fail Only
Lec-Rec-Lab: (0-2-3)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0470 - Advanced Listening and Speaking II
For students of English as a second language, not for native speakers of English. Further development of oral fluency, academic listening strategies, argument development, skills needed for group work, and academic presentation skills with a focus on persuasive speaking.
Credits: 3.0; Graded Pass/Fail Only
Lec-Rec-Lab: (0-2-3)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0471 - Advanced Pronunciation II
For students of English as a second language, not native speakers of English. Emphasis on prosodic elements of second language speech. Focus on producing features of speech. Time is divided between classroom instruction and lab.
Credits: 1.0; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0480 - Advanced Communicative Grammar II
For students of English as a second language, not native speakers of English. Using explicit instruction and form-focused activities to develop students' error analysis skills; further development on correcting sentence constructions and connections, verb consistency and other common errors.
Credits: 1.0; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0490 - Advanced Special Topics
For students of English as a second language, not for native speakers of English. Concentrated study in a specific area of ESL in greater depth than in other courses. Examples: academic writing, business English. Contact Director of ESL Programs.
Credits: variable to 6.0; May be repeated; Graded Pass/Fail Only
Restrictions: On Demand
Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0491 - Transitional Writing
For students of English as a second language, not for native speakers of English. Students work collaboratively on writing tasks of various genres through multiple drafts; emphasizes argument construction/deconstruction, source integration, sentence variety and cohesion.
Credits: 3.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-2-3)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0492 - Transitional Listening and Speaking
For students of English a second language, not for native speakers of English. Emphasis is on developing oral fluency, academic listening strategies, research skills, skills needed for group work and academic presentation skills with a focus on academic research projects.
Credits: 3.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-2-3)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0493 - Transitional Reading and Vocabulary
For students in English as a second language, not for native speakers of English. This course emphasizes the continued acquisition of higher level reading skills needed for university courses, expansion of receptive and productive academic vocabulary, comprehension of authentic American university texts as well as other authentic reading materials of varying lengths.
Credits: 3.0; Graded Pass/Fail Only
Lec-Rec-Lab: (0-2-3)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0494 - Advanced Reading and Vocabulary
For students in English as a second language, not for native speakers of English. This course emphasizes the continued acquisition of higher level reading skills needed for university courses, expansion of receptive and productive academic vocabulary, comprehension of authentic American university texts as well as other authentic reading materials of varying lengths.
OLY 0495 - TOEFL Preparation
This course is designed for students of English as a second language, not for native speakers of English. Emphasis is on the English used in colleges and universities in preparation for taking the TOEFL (Test of English as a Foreign Language).
Credits: 1.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0499 - Advanced Independent Study
For students of English as a second language, not for native speakers of English. Selected areas of ESL based on student need. Interested students should contact the Director of English as a Second Language Programs.
Credits: variable to 6.0; May be repeated; Graded Pass/Fail Only
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0520 - Academic Support Listening/Speaking
For students of English as a second language; not for native speakers of English. Emphasis on improving pronunciation and conversation skills; academic discussion skills; academic presentations.
Credits: 3.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language; May not be enrolled in one of the following Class(es):
Freshman, Sophomore, Junior

ESL 0560 - Research Writing I
For international graduate students of English as a second language, not for native speakers of English. Students work on improving academic reading and writing skills; emphasizes rhetorical analysis, cohesion and coherence, source use, research skills and syntactical accuracy.
Credits: 3.0; Graded Pass/Fail Only
Lec-Rec-Lab: (0-2-3)
Semesters Offered: Fall

ESL 0580 - Research Writing II
For international graduate students of English as a second language, not for native speakers of English. Students work on improving academic reading and writing skills; emphasizes graduate research writing and academic presentations.
Credits: 3.0; Graded Pass/Fail Only
Lec-Rec-Lab: (0-2-3)
Semesters Offered: Spring

ESL 0590 - Academic Support Spec Topics
For students of English as a second language, not for native speakers of English. Study a specific area of ESL in greater depth than in other courses. Examples: graduate/research writing, business English, academic presentations. Contact Director of ESL Programs.
Credits: variable to 4.0; May be repeated; Graded Pass/Fail Only
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language; May not be enrolled in one of the following Class(es):
Freshman, Sophomore, Junior

ESL 0599 - Academic Support Indep Study
For students of English as a second language, not for native speakers of English. Selected areas in ESL based on student need and interest. Interested students should contact the Director of English as a Second Language Programs.
Credits: variable to 6.0; May be repeated; Graded Pass/Fail Only
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

Visual and Performing Arts

FA 1662 - Introduction to Audio Production
An introduction to hands-on creative and technical work in sound. Work covers script analysis, story telling approaches, dialog direction and editing, sound effect and ambiance design, music integration and DAW based mixing.
Credits: 1.0
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall

FA 1664 - Introduction to Music Mixing
A hands-on introduction to mixing music with emphasis on the support of musical principles and style. Students develop a technical understanding and practice the manipulation of volume, frequency, dynamics, pitch, and time to support the focus, rhythm, melody, and mood of a wide variety of musical styles.
Credits: 1.0
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Spring

FA 1701 - Backstage Technology
Overview of the basic techniques, theories, and terminology of technical theatre. Focus on practical application of stagecraft and rigging for a theatrical production, safety in technical theatre, physical theatre structures, production processes, and theatre organization.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring

FA 1702 - Lighting and Sound Technology
Overview of the basics of theatrical lighting, stage electronics, audio systems, and techniques for theatrical production. Focus on practical application of static and automated lighting for a theatrical production, including instrumentation and control. Introduction to live sound reinforcement, recording, and complex playback.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring

FA 1703 - Costume Technology
Introduction to basics of costume shop technology, costume construction/sewing. Focus on costume shop procedures, practical use of tools, machines, and techniques through individual projects and costuming for mainstage productions. Overview of hand sewing and pattern fitting/alteration.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall

FA 2050 - Drawing I
Exploration and practice of fundamental principles of drawing. Develops skills in representational drawing, perspective, and composition. Develops creative and modern drawing techniques using a wide range of subject matter. Multimedia presentations and discussions illustrate classic principles while encouraging development of individual expression.
Credits: 3.0
Lec-Rec-Lab: (0-0-4)
Semesters Offered: Fall, Summer

FA 2112 - Creating Music
Explores the art of contemporary acoustic and electronic composition providing students with hands on opportunities to study and create music.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand

FA 2150 - Creative Drawing
Students redefine "drawing" and challenge preconceptions of what it means to be "creative" through a range of exercises using pencils, photos, video, and collage. Practice close observation to see the world in new ways.
Credits: 3.0
Lec-Rec-Lab: (0-0-4)
Semesters Offered: Fall, Spring

FA 2190 - Art and Nature
Explore nature through creative practices using media ranging from drawing, to rocks and twigs, to sound and video. Visits to natural sites provide inspiration and practice with creative fundamentals. Explore systems thinking, ideation, project development, collaboration, and critique.
Credits: 3.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Fall, Spring - Offered alternate years beginning with the 2017-2018 academic year

FA 2200 - Watermedia I
Introduction to the unique visual and expressive possibilities inherent in the use of watermedia painting. Equal emphasis on perception, practice, and exploration. Development of basic understanding of watermedia, color principles, line, form, and composition, including watermedia principles of both traditional and contemporary masters. Development of individual thinking and creative expression.
Credits: 3.0
Lec-Rec-Lab: (0-0-4)
Semesters Offered: On Demand

FA 2222 - Film Music
This course surveys the development of film music. Students will learn how music functions to support the aesthetic/narrative elements of the story. Students will learn skills to identify how music manipulates the listener and how composers shape that manipulation.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Summer
FA 2300 - Two-Dimensional Design
Introduction to design that explores color, graphics, composition, and images in 2D media. Class examines design's ability to shape alter interpretations of information, place, and accessibility. Creative studio practices, short lectures, discussions. Emphasizes creativity, inventiveness, and experimentation.
Credits: 3.0
Lec-Rec-Lab: (0-0-4)
Semesters Offered: Fall, Spring

FA 2305 - Ceramics I
Introduces handbuilding ceramic techniques, including coil, slab and pinch construction. The goal is to allow students to be individually creative through experimenting with the possibilities in three-dimensional form. Available from instructor. One semester may be counted toward General Education co-curricular requirements.
Credits: 3.0
Lec-Rec-Lab: (0-0-4)
Semesters Offered: Fall, Summer

FA 2315 - Beginning Wheel Throwing
Learning to use the potters wheel as an expressive tool is the goal of this course. In the context of traditional techniques for creating vessel forms students will also be challenged to explore their individual expressive and creative abilities.
Credits: 3.0
Lec-Rec-Lab: (0-0-4)
Semesters Offered: Fall

FA 2320 - Color and Meaning
This course will introduce the student to additive and subtractive practical principles of color theory in relation to visual communication. The course will cover cultural, psychological, and symbolic meaning of color in its diverse array of contexts.
Credits: 3.0
Lec-Rec-Lab: (0-0-4)
Semesters Offered: Spring

FA 2330 - Art Appreciation
Introduces students to analytical tools to critically observe the visual world. By studying arts media, artists and designers, creative and technical processes, principles of design, as well as major works of art, students will express their own ideas about the visual experience in written form.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring, Summer

FA 2400 - Huskies Pep Band
The Huskies Pep Band provides enthusiastic support for a number of athletic programs at MTU and participates in important events in the community. The HPB is one of the most visible programs in the University. We are known as one of the country's most spirited college pep bands anywhere. May be used once as a general education co-curricular course.
Credits: 1.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Fall, Spring

FA 2402 - Campus Concert Band
The Concert Band provides the opportunity for students to pursue an interest in instrumental performance through the medium of a concert wind band. Repertoire of the ensemble includes music of the highest caliber with moderate technical demands. Open to students with prior experience in a band or orchestra. May be used once as a general education co-curricular course.
Credits: 1.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Fall, Spring

FA 2403 - Research and Development Jazz Band
The Research and Development Jazz Band is for instrumentalists wishing to learn the fundamentals of jazz improvisation and the nuances of the jazz idiom. Repertoire includes swing, jazz, rock, Latin, ballads, fusion, and other contemporary jazz styles. Public performances are given on campus and in the surrounding area. Audition required.
Credits: 1.0; May be repeated
Lec-Rec-Lab: (0-3-3)
Semesters Offered: Fall, Spring

FA 2500 - Music Theory I
Reinforcement of musical fundamentals, including musical notation; major, minor scales; intervals; triads; rhythm; and an introduction to musical analysis. Provides rudimentary ear training. Introduces music writing, both manual and with notation software.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Summer

FA 2501 - Basic Musicianship: Skill Acquisition in Music Reading, Sight-Singing, and Ear-Training
Skill acquisition in music reading, sight-singing, keyboard harmony and ear-training. Provides an introduction to melodic and rhythmic college systems. Class should be taken before or concurrently with FA2500.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall

FA 2520 - Music Appreciation
Survey of the nature of Western music with an emphasis on the developments in the aesthetics, theories, and media of music, including electronic music, multimedia works, and non-Western influences.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring, Summer

FA 2570 - Music Lessons for Brass, Woodwind, String, Percussion, Harp, Piano, Voice, Guitar
Professional private music instruction on brass, woodwind, string, piano, guitar, voice, and harp. Concert grand harp available on campus. Guitar rentals available from instructor. One semester may be counted toward General Education co-curricular requirements.
Credits: 0.5; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-1)
Semesters Offered: Fall, Spring, Summer

FA 2580 - Group Voice
The fundamentals of speech and singing including information about the vocal instrument, the vocal process, vocal technique, and how to learn and perform simple solo songs.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring, Summer

FA 2600 - Beginning Acting
Teaches basic techniques of acting to include script and character analysis, internal and external approaches to performance, and basic use of voice and body.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring

FA 2640 - Stage Makeup
A practical guide to the theory and practice of makeup for the stage. Students will study basic techniques including corrective, aging, character makeup, and special effects.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2009-2010 academic year
Pre-Requisite(s): FA 2600

FA 2660 - Audition Techniques
Students learn to prepare for the many types of auditions encountered in the professional world of performance through simulated audition situations, from the theatrical cattle-call to the screen test in film. Additionally, professional interviewing techniques are taught and practiced through simulation.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2016-2017 academic year
Pre-Requisite(s): FA 2600

FA 2669 - Acting Practicum
Performance in a stage production or electronic media project. The project must be approved by the instructor either through audition or written contract of planned project.
Credits: 1.0; May be repeated
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required

FA 2661 - Backstage Practicum
Open to students selected for the crew of a mainstage theatre production sponsored by the Department of Visual and Performing Arts. Positions on stage crews are open to all MTU students. Work assignments will be made by the technical director of the Department of Visual and Performing Arts.
Credits: variable to 3.0; May be repeated
Semesters Offered: Fall, Spring

FA 2662 - Sound Practicum
Students get hands-on experience in live and recorded sound as well as in system maintenance and design. This work is done in a simulated internship experience. Students are expected to take this course multiple times and work towards leadership positions.
Credits: variable to 3.0; May be repeated
Semesters Offered: Fall, Spring
Pre-Requisite(s): FA 1702 and (FA 1662 or FA 1664)

FA 2663 - Career Development
Provides students the opportunity to attend professional events which contribute to the development of their careers. Students will experience seminars, workshops, performance opportunities, competitions, and may perform services and interact with professionals at such events as KCACFT, AES, USITT, and URITA.
Credits: 1.0; Repeatable to a Max of 6
Lec-Rec-Lab: (0-0-1)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Major(s): Sound Design, Theatre & Entertain Tech (BS), Theatre & Electr. Media Perf., Audio Production & Technology
FA 2701 - Drafting for the Entertainment Industry
Basics of hand drafting conventions and standards used in the entertainment industry. Focus on design and technical techniques for views such as: ground plans, elevations, sections, detail drawings, orthographic projections, scale perspective drawings. Introduces industry-specific CAD programs.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring, Summer

FA 2710 - Movement for Performers
Develops physical flexibility and strength, beginning with discovery of the body's physical center. The student will learn to create characters by focusing on posture, movement in space, and kinesics.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2009-2010 academic year

FA 2720 - Audio Arts Appreciation
Overview of sound: engagement with critical, historical, and creative approaches to sound in Film, Television, Theatre, Art, and Music. Integrated with a historical overview of aural environment and attempts to design environment from zen gardens to Harley exhaust.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2014-2015 academic year

FA 2820 - Theatre Appreciation
Survey of the nature of theatre from the classics to the twentieth century, emphasizing procedures of play production. Includes the roles of playwright, actor, director, and designer, and examines theories of modern theatre production.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring, Summer

FA 2830 - Voice and Articulation
An applied study of the use of voice. Students work to develop a stronger, more vibrant and articulate professional speech. Accent reduction is covered extensively.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2010-2011 academic year

FA 3000 - Visual & Performing Arts Tour
Students participating in fine arts performance tours taking place outside of regular academic terms are eligible to receive credit based on the time span of the tour and the nature of the itinerary. Requires active membership in the touring group or permission of director.
Credits: variable to 3.0; May be repeated; Graded Pass/Fail Only
Restrictions: Permission of instructor required

FA 3112 - Music Composition I
This course is a study in the art of acoustic instrumental, vocal and MIDI composition. Students will study music of contemporary composers and create compositions for performance.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): FA 2500 and FA 3530

FA 3122 - Music Composition II
This course is a continuation of Music Composition I. Students expand their skills to include composition for media including, film, television, and digital arts. Students will apply their skills to create fully realized live performances of their compositions.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): FA 2500 and FA 3530 and FA 3112

FA 3133 - Contemporary Music: The Search for New Sounds
Contemporary Music will explore music from the late nineteenth century through today. The focus of the class will be modern composers' search for new sounds using electronic instruments, popular music, non-western music, and new performance techniques.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2013-2014 academic year
Pre-Requisite(s): FA 2500 and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

FA 3150 - Drawing II
Observational and imaginative drawing including the human figure. Non-representational drawing. Contemporary drawing systems, concepts, and processes. Emphasizes proportion, structural framework, visual measurement, movement, and relationships. Students work in a variety of drawing media.
Credits: 3.0
Lec-Rec-Lab: (0-0-4)
Semesters Offered: Spring
Pre-Requisite(s): FA 2050 or FA 2150 or FA 2200 or FA 2300 or FA 2305 or FA 2330

FA 3200 - Creative Watermedia
In-depth study of watermedia painting with attention given to individual tendencies and preferences. Emphasizes personal solutions and experimental approaches to image making and mixed media explorations. Exploration of traditional and contemporary concepts in watermedia painting with emphasis on relationship between form and content.
Credits: 3.0
Lec-Rec-Lab: (0-0-4)
Semesters Offered: On Demand

FA 3300 - Three-Dimensional Design
Introduction to design that explores visual arts, graphics, architecture, community engagement, and conceptual work in 3D media. Class uses design to address environmental issues creatively. Connections between art, science, and technology are also explored. Emphasizes creativity, inventiveness, experimentation, and collaboration.
Credits: 3.0
Lec-Rec-Lab: (0-0-4)
Semesters Offered: Spring
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

FA 3305 - Creative Ceramics
Addresses ceramic theory, history, and science, and aims to develop the content and quality of students' work in clay. Students will learn new ways of creating forms through use of the wheel, molds, and study of clay and glaze technologies.
Credits: 3.0
Lec-Rec-Lab: (0-0-4)
Semesters Offered: Spring, Summer

FA 3339 - Art History - Prehistory to Renaissance
Surveys world art and architecture from the Paleolithic (30,000BC) to the Renaissance (1500AD). Focusing on city building, cave painting, glass, ceramics, frescoes, and metal casting, students will interpret the visual arts as historical evidence and expressions of cultural beliefs.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

FA 3333 - Sculpture
This class introduces fundamental issues in sculpture such as site, context, process, psychology, and aesthetics. A variety of methods will be explored, and students will develop work in both traditional and non-traditional process. The class will include studio work and lectures.
Credits: 3.0
Lec-Rec-Lab: (0-0-4)
Semesters Offered: Fall, Spring

FA 3335 - Sculpture II
Explores the material properties and expressive potential of plaster, clay, and found objects, approaching sculpture from the perspective of contemporary practices. Increases knowledge of traditional materials and techniques while encouraging students to experiment with new processes.
Credits: 3.0
Lec-Rec-Lab: (0-0-4)
Semesters Offered: On Demand
Pre-Requisite(s): FA 3333

FA 3340 - Art History - Renaissance to Today
Surveys Western art from the Renaissance (1500AD) to today. Focusing on painting, sculpture, architecture, decorative arts, graphic arts, and photography, we will study art in relation to its national, international, social, cultural, and historical contexts, including the marketplace and patronage.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)
Lec-Rec-Lab: Credits: A history of making things, craft, and production in America. Includes creative choices, early modern production techniques, markets, technological changes, anti-modern reactions to industrialization, post-war globalization, and current craft and design. Contextualizes historical styles in architecture and furnishings.
Credits: 3.0
Semesters Offered: Fall, Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman Pre-Requisite(s): FA 2330 or FA 3340 and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

FA 3360 - Ceramic Sculpture
Explores the material properties and expressive potential of clay. Learning a variety of sculptured techniques, students will demonstrate the ability to incorporate the elements and principles of art (line, space, form, harmony) to create aesthetic artwork.
Credits: 1.0
Semesters Offered: On Demand
Pre-Requisite(s): FA 2305 or FA 3305

FA 3400 - Keweenaw Symphony Orchestra
The KSO is a college-community orchestra comprising Tech students, Tech faculty, and community musicians. The ensemble performs the great orchestra, opera, and ballet masterworks. The orchestra presents four yearly concerts, including a biennial concert tour. Audition info at: berloz.wix.com/kso-website.
Credits: 1.0; May be repeated
Semesters Offered: Fall, Spring

FA 3401 - Wind Symphony
The Wind Symphony is a concert wind ensemble of variable size and instrumentation for students with a serious interest in musical performance at a high level. Features a comprehensive approach to the literature to be performed, including study of composers and historical background. Audition required.
Credits: 1.0; May be repeated
Semesters Offered: Fall, Spring
Restrictions: Permission of instructor required

FA 3430 - Jazz Lab Band
A select ensemble of approximately twenty instrumentalists studying jazz improvisation and performing literature for the jazz ensemble. Repertoire includes swing, jazz-rock, ballads, fusion, and experimental compositions. Activities include performances at festivals, concerts, and dances, and a spring-break tour. Course work includes topics in jazz history, music theory, and improvisation. Audition required.
Credits: 1.0; May be repeated
Semesters Offered: Fall, Spring

FA 3501 - Conducting and Interpretation
Fluency in reading, analyzing, and interpreting orchestral, band, and choral music scores; principles and techniques of conducting a music ensemble; live conducting experiences with music ensembles; in-depth analysis of live and recorded classical, jazz, and rock music; fundamentals of musicianship.
Credits: 3.0
Semesters Offered: Fall, Spring

FA 3510 - Concert Choir
A select ensemble made up of student and community singers studying and performing traditional choral literature ranging from chant to avant-garde compositions. Activities include campus and community performances and occasional international tours. Audition required.
Credits: 1.0; May be repeated
Semesters Offered: Fall, Spring, Summer

FA 3530 - Music Theory II
Study of fundamentals of tonal harmony, including harmonic progression and principles of voice-leading. Introduction to formal and harmonic analysis. Students will complete beginning projects in music composition.
Credits: 3.0
Semesters Offered: Spring, Summer
Pre-Requisite(s): FA 2500

FA 3550 - History of Jazz
Covers the musical, historical, and sociological elements of America's only original musical art form, jazz. Focuses on the major stylistic eras from 1900 to the present in addition to the major artists and their contributions. Emphasizes developing interactive, aural, and critical skills.
Credits: 3.0
Semesters Offered: Fall, Summer - Offered alternate years beginning with the 2009-2010 academic year
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

FA 3560 - Music History
Developments in western classical music from the 1770s to 1970s in Europe and America. Includes a brief examination of Baroque music. Concentrates on music, style, aesthetics, culture, and biographies of major composers from the Classical, Romantic, and Twentieth-Century periods.
Credits: 3.0
Semesters Offered: Spring, Summer
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

FA 3565 - Masterworks in Western Music Literature
Examination of selected works from the canon of Western Music in context of relevant historical events. Students will explore the relation of text and music, ritual and music, rhetorical tropes in music as well as expressions of musical form.
Credits: 3.0; Repeatable to a Max of 6
Semesters Offered: Fall - Offered alternate years beginning with the 2013-2014 academic year
Pre-Requisite(s): FA 2500(C) or FA 2501(C)

FA 3580 - Chamber Choir
Participation in the Chamber Choir provides opportunities for students to explore and perform music written for small choir. Repertoire from varied styles and time periods (from antiquity to the present) will be prepared and presented in formal and informal performance settings. Audition required.
Credits: 1.0; May be repeated
Semesters Offered: Fall, Spring

FA 3600 - Advanced Acting
Students explore acting through analytical and theoretical study of script and characters. Understanding of characters in the context of a play or film will prepare students to apply advanced acting techniques such as Meisner and Stanislavski.
Credits: 3.0
Semesters Offered: Fall, Spring

FA 3620 - Acting for Television and Film
Advanced applications of fundamental acting technique and presentation skills with the added dynamic of the camera. Students will explore scene work for television and film, as well as commercial performance techniques for advertising in digital media.
Credits: 3.0
Semesters Offered: Spring

FA 3625 - History of Rock
This course will acquaint the student with the musical, historical, cultural, and sociological elements of Rock Music. It covers the major stylistic eras from 1948 - present, the “pre-rock” era and the major artists and their contributions. Emphasis is placed on students developing interactive, aural and critical skills.
Credits: 3.0
Semesters Offered: Fall, Summer - Offered alternate years beginning with the 2016-2017 academic year

FA 3630 - The Beatles and the Beach Boys: An Analysis of Their Music, Their Evolution, Their Rivalry
Analysis of biography, formative vs. mature style, musical structure, and historical impact of both bands. Offered online, second half of summer term.
Credits: 3.0
Semesters Offered: Summer

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FA 3650 - Stage Management
Procedures and skills for effective stage management of theatrical productions, including coordination of performers and technicians during rehearsal and performance periods. Instruction in stage manager’s notation used for blocking, scene shifts, and cues for lighting, sound, special effects, and performers.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2009-2010 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman

FA 3661 - Design & Management Practicum
Open to students who take significant responsibility for a Visual and Performing Arts production, such as stage manager, assistant designer, or assistant director.
Credits: variable to 3.0; May be repeated
Semesters Offered: Fall, Spring
Pre-Requisite(s): FA 2681

FA 3662 - Advanced Sound Practicum
Open to students who take significant responsibility for sound on a major production, such as sound designer, recording engineer, live sound engineer.
Credits: variable to 3.0; May be repeated
Semesters Offered: Fall, Spring
Pre-Requisite(s): FA 1662 and FA 1664 and FA 1702 and FA 2662 and FA 3730

FA 3663 - Professional Presentation
Provides students the opportunity to present at professional events which contribute to the development of their careers. Students will prepare and present design, technical, or performance projects, papers, and/or posters to be viewed and critiqued by professionals at such events as KCACTF, AES, USITT, and URTA.
Credits: 1.0; Repeatable to a Max of 4
Lec-Rec-Lab: (0-0-1)
Semesters Offered: Fall, Spring
Pre-Requisite(s): FA 3700(C) or FA 3730(C) or FA 3750(C) or FA 3760(C)

FA 3680 - Period Acting Styles
Provides knowledge and experience in playing the manners, movement, and language in plays of the most frequently performed periods.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2008-2009 academic year
Pre-Requisite(s): FA 2600 or FA 2820

FA 3700 - Scenic Design
Fundamentals of designing theatrical scenery through various explorations and projects. Focus on professional design development and presentation techniques: theatrical drafting conventions, renderings, scale models. Also, designer/director relationships, script analysis, research design concepts/history/styles. Students are introduced to a mainstage theatre design.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2000-2001 academic year
Pre-Requisite(s): Must be enrolled in one of the following Class(es): Freshman

FA 3701 - Advanced Backstage Technology
Techniques, theories, and terminology of technical theatre. Focus on practical application of advanced stagcraft through safety, woodworking, metalworking, budgeting, project management, and shop management.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2011-2012 academic year
Pre-Requisite(s): FA 1701 or FA 2820

FA 3703 - Advanced Costume Construction
Building on basic sewing skills and costume technology, students will explore fabrics and more advanced construction techniques: patterning methods such as flat patterning, draping, grading, pattern alterations for fit and using slopers, construction of historical costumes such as corsets.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2015-2016 academic year
Pre-Requisite(s): FA 1703

FA 3710 - Vocal Approaches for Theatre and Electronic Media
Students will learn vocal approaches to specific types of speaking situations, including radio commercials, instructional videos, announcing, cartoons, and theatrical productions. Students will practice vocal projection for a large theatre/auditorium, as well as microphone technique for electronic media.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2008-2009 academic year

FA 3730 - Sound Design
Introduction to designing sound through design projects. Focuses on fundamental technical understanding, practical design presentation techniques, specific drafting conventions, exploration of sound equipment, designer/designer/artist relationships, script analysis and design concepts, and design history.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): FA 1662 and FA 1664 and FA 1702

FA 3731 - Live Sound Design Intensive
Students design, install, program, run, and record a major live production. Sound will be an essential part of the story telling experience requiring a close relationship with the actors and extensive integration with other design elements.
Credits: 1.0
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Spring
Pre-Requisite(s): Must be enrolled in one of the following Class(es): Freshman

FA 3732 - Audio Creative Lab
A creative lab for students interested in the aural arts. Students will be challenged to create sound designs and compositions in response to various aesthetic, dramatic, and philosophical goals for radio, multimedia, and live performance.
Credits: 3.0; Repeatable to a Max of 4
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Spring

FA 3736 - Sound Systems Design and Engineering
Fundamentals of sound systems design & engineering for a variety of entertainment industry scenarios, including: speaker coverage, system tuning, DSP programming, technical documentation, design phases, revision control, interaction with clients, interaction with design teams in other disciplines, and budget estimation.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2015-2016 academic year
Pre-Requisite(s): Must be enrolled in one of the following Class(es): Freshman

FA 3740 - Recording
Learning in the art of the recording engineer. Students develop an understanding of pop and classical recording approaches, skills to decide which approach is appropriate for a given task, and the technical knowledge necessary to implement the chosen approach.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Pre-Requisite(s): Must be enrolled in one of the following Class(es): Freshman

FA 3741 - Recording Lab
Hands-on learning in the art of the recording engineer. Students develop an understanding of pop and classical recording approaches, skills to decide which approach is appropriate for a given task, and the technical knowledge necessary to implement the chosen approach.
Credits: 1.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Spring
Pre-Requisite(s): Must be enrolled in one of the following Class(es): Freshman

FA 3750 - Lighting Design
Fundamentals of designing theatrical lighting through various explorations and projects. Focus on professional design development and presentation techniques: theatrical drafting conventions, light sketches, plots. Also, designer/designer/artist relationships, script analysis, research, design concepts/history. Students are introduced to a mainstage theatre design.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2005-2006 academic year
Pre-Requisite(s): Must not be enrolled in one of the following Class(es): Freshman

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FA 3760 - Costume Design
Fundamentals of designing theatrical costumes through various explorations and projects. Focus on professional design development and presentation techniques: costume renderings, patterning, color/fabric analysis. Also, designer/director relationships, script/character analyses, research, design concepts. Students are introduced to a mainstage theatre design.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2003-2004 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman

FA 3780 - Directing for Theatre
A comprehensive, in-depth study of mounting a theatre production with an emphasis on directing. Through script analysis, students study the necessary production elements, how they interrelate, and directing techniques to create a unified production from the director's vision.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Permission of instructor required
Pre-Requisite(s): FA 2800

FA 3810 - Ancient Theatre History
Study of the Cultural History of Theatre from is likely beginnings through the English Restoration, including traditions of both eastern and western theatre.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

FA 3821 - Modern Theatre History
Study of the Cultural History of Theatre from the end of the English Restoration through the contemporary era.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

FA 3830 - The Broadway Musical
A multimedia examination of important works of American musical theatre, how these works have mirrored or shaped our culture, and how New York City has shaped or been shaped by this vibrant art form.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2012-2013 academic year
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

FA 3880 - Readings in Dramatic Literature
An examination of dramatic literature with an emphasis on theatre production. Students will examine a selection of plays each semester. Students can repeat the course up to four times; each semester examines different plays.
Credits: 1.0; Repeatable to a Max of 4
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Major(s): Sound Design, Theatre & Entertain Tech (BS), Theatre & Electr. Media Perf., Audio Production & Technology; May not be enrolled in one of the following Class(es): Freshman

FA 3975 - Portfolio Development
Techniques for building a professional design and technical portfolio for the theatre and entertainment industry. The final result of the course will be a portfolio of all work to date.
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

FA 4150 - Advanced Drawing Studio
Advanced independent exploration and experimentation in drawing theory and use of various drawing media. Students identify a problem or area of interest and develop an approach to it in close consultation with a faculty member, experimenting with a variety of media and methods.
Credits: variable to 6.0; Repeatable to a Max of 6
Semesters Offered: Fall, Spring
Restrictions: Permission of instructor required
Pre-Requisite(s): FA 2050 or FA 2150

FA 4190 - Art and Nature
Explore nature through creative practices using media ranging from drawing, to rocks and twigs, to sound and video. Visits to natural sites provide inspiration and practice with creative fundamentals. Explore systems thinking, ideation, project development, collaboration, and critique.
Credits: 3.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Fall - Offered alternate years beginning with the 2017-2018 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

FA 4200 - Advanced Watermedia Studio
Advanced work in watermedia painting. Reading and theory as well as advanced applications of personal expression in watermedia may be included. Emphasis on independence in approach to materials, techniques, and concepts.
Credits: variable to 6.0; Repeatable to a Max of 6
Semesters Offered: On Demand
Restrictions: Permission of instructor required
Pre-Requisite(s): FA 2200 or FA 3200

FA 4300 - Advanced Sculpture Studio
In depth personal study of a specific sculptural problem or studio exploration. Proposed by the individual student and supervised by the faculty. Requires a written proposal including resources needed, budget for the project, and proposal schedule for weekly work.
Credits: variable to 6.0; Repeatable to a Max of 6
Semesters Offered: On Demand
Restrictions: Permission of instructor required

FA 4400 - Chamber Music Seminar
For students interested in the study and performance of instrumental chamber music. Small ensembles meet once each week for coaching, presentations, and discussion on literature and techniques of rehearsal and performance.
Credits: 1.0; Repeatable to a Max of 6
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall, Spring
Restrictions: Permission of instructor required

FA 4420 - Music Performance: Jazz
Jazz combos (e.g., Jazztec, Salsa Norte) are select small groups of musicians studying jazz improvisation and performing literature for the small jazz ensemble. Focuses on developing individual improvisational techniques, personal style, and unique original arrangements. Repertoire includes swing, jazz-rock, ballads, fusion, and experimental techniques. Activities can include performances and tours.
Credits: variable to 3.0; Repeatable to a Max of 6
Semesters Offered: Fall, Spring
Restrictions: Permission of instructor required

FA 4620 - Musical Theatre Performance
Provides specialized experience in performance styles of the musical theatre through scene-study and process from sheet music to the stage.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2009-2010 academic year
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

FA 4740 - Transducer Theory
In depth study of Microphone and Loudspeaker design as it applies to usage in recording and live sound reinforcement with an emphasis on interaction with the acoustical environment.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Major(s): Theatre & Entertain Tech (BS), Sound Design, Audio Production & Technology
Co-Requisite(s): FA 4741
Pre-Requisite(s): FA 1702 and FA 2662 and FA 3730 and PH 1090
Finance

FIN 3000 - Principles of Finance
Introduction to the principles of finance. Topics include financial mathematics, the capital investment decision, financial assets valuation, and the risk-return relationship.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): (MA 2710 or MA 2720 or MA 3710 or BUS 2100) and ACC 2100(C)

FIN 4000 - Investment Analysis
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): EC 3400 or FIN 3000

FIN 4100 - Advanced Financial Management
Advanced topics in managerial finance: Advanced capital budgeting, project analysis, capital acquisition, capital structure and dividend policy, and other topics.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): EC 3400 or FIN 3000

FIN 4200 - Derivatives and Financial Engineering
Covers the pricing and use of options, financial futures, swaps, and other derivative securities.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): BA 3400 or EC 3400 or FIN 3000

FIN 4400 - Security Analysis
Detailed analysis of security valuation. Topics include fundamental analysis (financial statement analysis, free cash flow valuation, credit analysis, ratio analysis), technical analysis, and quantitative analysis.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): BA 3400 or EC 3400 or FIN 3000

FIN 4500 - Financial Risk Management and Financial Engineering
Detailed analysis of the measurement of financial risk and the tools and techniques available to manage financial risk. Topics include financial disasters, risk measurement (market, default, currency exchange, value-at-risk) and the hedging of these risks.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): FIN 3000 or EC 3400

FIN 4700 - Global Finance
Studies international financial systems and markets. Covers the principle of comparative advantage, balance of payments, exchange rate systems, theories of international finance, identification of international risk exposures, the management and treatment of risk, and special topics of international finance.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): BA 3400 or EC 3400 or FIN 3000
FIN 4801 - Applied Portfolio Management I
Covers issues in the management and administration of investments in an institutional setting. Students form a new investment firm and manage a real portfolio of financial assets.
Credits: variable to 3.0
Semesters Offered: Summer
Restrictions: Permission of instructor required; May not be enrolled in one of the following Class(es): Freshman, Sophomore

FIN 4802 - Applied Portfolio Management II
Covers issues in the management and administration of investments in an institutional setting. Students form a new investment firm and manage a real portfolio of financial assets.
Credits: variable to 3.0
Semesters Offered: Fall
Restrictions: Permission of instructor required; May not be enrolled in one of the following Class(es): Freshman, Sophomore

FIN 4803 - Applied Portfolio Management III
Covers issues in the management and administration of investments in an institutional setting. Students form a new investment firm and manage a real portfolio of financial assets.
Credits: variable to 3.0
Semesters Offered: Spring
Restrictions: Permission of instructor required; May not be enrolled in one of the following Class(es): Freshman, Sophomore

FIN 4990 - Special Topics in Finance
Examines current issues in Finance and other topics of interest to faculty and students in greater depth.
Credits: variable to 3.0
Repeatable to a Max of 6
Semesters Offered: On Demand
Pre-Requisite(s): EC 3400 or FIN 3000

Forest Resources & Environmental Science

FW 1035 - Wood Anatomy and Properties
An introduction to the micro- and macro-anatomy of wood, how wood structure is related to its function in the tree, wood quality, physical properties, and its utilization as an industrial raw material.
Credits: 4.0
Lec-Rec-Lab: (3-0-3)
Semesters Offered: Spring

FW 1050 - The Natural Resources Professional
Seminar introduces students to the various careers within forestry, conservation, ecology, and wildlife that represent specialties within natural resources.
Credits: 2.0
Lec-Rec-Lab: (2-0-0)
Semesters Offered: Spring

FW 2000 - Environmental Science
This is an interdisciplinary course that emphasizes the impact of humans on the environment. The course applies biological, chemical, and physical principles to the study of the environment, environmental problems and their potential solutions.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring

FW 2010 - Vegetation of North America
Identification of trees and shrubs. Study of seed dispersal, dormancy, and community ecology, with an emphasis on trees. Systematic study of the major forested vegetation types of North America.
Credits: 4.0
Lec-Rec-Lab: (2-0-4)
Semesters Offered: Fall

FW 2030 - Natural Resources Conservation
This course explores the history and evolution of conversation in thought and practice, with an emphasis on the writings and legacy of conservation pioneers such as Aldo Leopold.
Credits: 2.0
Lec-Rec-Lab: (2-0-0)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Class(es): Freshman

FW 2051 - Field Techniques
Equipment and techniques used to measure forest ecosystem attributes and perform fieldwork. Topics include field safety, land measurement and navigation, establishment of sample locations, measurement of attributes of individuals and groups of trees, vegetation and other organisms.
Credits: 2.0
Lec-Rec-Lab: (1-0-3)
Semesters Offered: Fall

FW 3010 - Practice of Silviculture
Methods of controlling the establishment, growth, composition, health and quality of forests and woodlands to meet the diverse needs and values of landowners and society on a sustainable basis.
Credits: 4.0
Lec-Rec-Lab: (2-1-3)
Semesters Offered: Fall, Summer
Restrictions: Must be enrolled in one of the following Major(s): Forestry, Wildlife Ecology & Mgmt, App Ecol & Environ Sci
Pre-Requisite(s): FW 2010 and FW 2051

FW 3012 - Survey of Silviculture
An introduction to the practice of silviculture including ecological principles which form the basis for forest management. The course emphasizes proper use of silviculture terminology and includes field examples of management practices.
Credits: 2.0
Lec-Rec-Lab: (1-0-2)
Semesters Offered: Fall, Summer
Restrictions: Must be enrolled in one of the following Major(s): Forestry, Wildlife Ecology & Mgmt, App Ecol & Environ Sci
Pre-Requisite(s): FW 2010 and FW 2051

FW 3020 - Forest Ecology
Environmental factors and plant and animal characteristics which control composition, structure, and function of forest ecosystems. Emphasis on how ecosystems change across space and time and knowledge needed to sustainably manage forest ecosystems for social, economic, and ecological benefits.
Credits: 3.0
Lec-Rec-Lab: (2-0-3)
Semesters Offered: Fall
Pre-Requisite(s): FW 2010(C) and FW 2051(C)

FW 3075 - Introduction to Biotechnology
The course covers basic concepts and practical applications in biotechnology. Topics include the use of biotechnology in agriculture, healthcare, and environmental remediation. Advances in gene containment, regulatory, societal and environmental issues associated with commercialization of biotechnological products will be discussed.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring

FW 3098 - Wood Processing and Manufacture
A huge variety of products are manufactured from wood. Wood-based manufacturing plants in the upper Midwest are visited during the week prior to the start of the fall semester. Plant similarities and differences are discussed during class meetings.
Credits: 2.0
Lec-Rec-Lab: (2-0-3)
Semesters Offered: Fall - Offered alternate years beginning with the 2014-2015 academic year
Pre-Requisite(s): FW 1035

FW 3110 - Natural Resource Policy
Covers concepts related to social systems and natural resources. Offers a survey of natural resource policies and organizations. State and federal levels of policymaking will be linked to the human values, attitudes, and beliefs that set the context for natural resource policy processes.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring, Summer

FW 3115 - Natural Resources, Ethics, and the Environment
Students will develop basic skills in critical thinking and argument analysis to address the ethical dimension of conservation, sustainability, and natural resource management.
Credits: 2.0
Lec-Rec-Lab: (0-2-0)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Level(s): Graduate; May not be enrolled in one of the following Class(es): Freshman

FW 3150 - Timber Harvesting
Methods and techniques used in timber harvesting systems. Emphasizes best management practices, aesthetic and ecological impacts, logging cost analysis, timber appraisal, and timber sale preparation and administration.
Credits: 2.0
Lec-Rec-Lab: (1-0-3)
Semesters Offered: Fall, Summer
Restrictions: Must be enrolled in one of the following Major(s): Forestry
Pre-Requisite(s): FW 2051

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FW 3170 - Land Measurements and GPS
Introduces field measurements and computations involved in determining direction, distance, and area. Covers the hand compass, pacing, and use of GPS, including differential correction. Integration of GPS data with GIS is emphasized.
Credits: 1.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Fall, Summer
Restrictions: Must be enrolled in one of the following Major(s): Forestry, Wildlife Ecology & Mgmt, App Ecol & Environ Sci
Co-Requisite(s): FW 3190
Pre-Requisite(s): FW 3540

FW 3180 - Geomorphology, Landscapes and Ecosystems
Provides basic understanding of the geologic and glacial processes that shaped the landscape of the Upper Midwest influencing the distribution and productivity of modern-day plant communities. Topics include geology of Michigan, glacial geomorphology, soil development, landscape and community ecology, and forestry.
Credits: 2.0
Lec-Rec-Lab: (1-0-3)
Semesters Offered: Fall, Summer
Restrictions: Must be enrolled in one of the following Major(s): Wildlife Ecology & Mgmt, App Ecol & Environ Sci; May not be enrolled in one of the following Class(es): Freshman

FW 3190 - Multi-resource Assessment
Develops a basic proficiency in the application of multiple-resource measurement techniques. Gain familiarity with the application of individual tree and landscape measurements as well as estimation of growth, sampling techniques, computational procedures, and mapping procedures commonly used in forest and land management.
Credits: 3.0
Lec-Rec-Lab: (0-1-4)
Semesters Offered: Fall, Summer
Restrictions: Must be enrolled in one of the following Major(s): Forestry, Wildlife Ecology & Mgmt, App Ecol & Environ Sci
Pre-Requisite(s): FW 2051 and FW 3020 and FW 3200 and (MA 2710 or MA 2720 or MA 3710)

FW 3200 - Biometrics and Data Analysis
Sampling design, implementation and analysis for inventory and monitoring of attributes of stands, forests and landscapes. Includes computing skills for data entry, storage and analysis and application of statistical techniques to answer questions about ecological data.
Credits: 4.0
Lec-Rec-Lab: (3-0-3)
Semesters Offered: Spring
Pre-Requisite(s): FW 2051 and (MA 2710 or MA 2720 or MA 3710)

FW 3313 - Sustainability Science, Policy, and Assessment
Foundational scientific concepts (dynamic systems and catastrophe theory) as applied to socioecological systems. Use of indicators and indices to track progress towards sustainability goals. Review of local, national, and global sustainability policies to avoid catastrophes and guide sustainable development.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2016-2017 academic year
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

FW 3320 - Fundamentals of Forest Genetics and Genomics
This course will teach fundamental and applied genetic principles that are essential for management of forest and other ecosystems to maintain their long-term health and sustainability. The class will cover the following topics: structure and function of DNA, inheritance, molecular evolution, population and quantitative genetics, gene conservation, genomics and biotechnology.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

FW 3330 - Soil Science
Introduction to the chemical, physical, and biological properties of soil.
Credits: 4.0
Lec-Rec-Lab: (3-0-3)
Semesters Offered: Fall
Pre-Requisite(s): CH 1112(C) or (CH 1150(C) and CH 1151(C))

FW 3376 - Forest & Environmental Resource Management (The FERM) I
Application of forest and environmental management practices by teams of students with the assistance of faculty, staff and representatives of state, federal and corporate land management groups as well as non-governmental organizations.
Credits: 2.0; May be repeated
Lec-Rec-Lab: (0-2-0)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): FW 2010 and FW 2051

FW 3377 - Forest & Environmental Resource Management (The FERM) II
Application of forest and environmental management practices by teams of students with the assistance of faculty, staff, and representatives of state, federal, and corporate land management groups as well as non-governmental organizations.
Credits: 3.0; May be repeated
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): FW 2010 and FW 2051

FW 3410 - Conservation Biology
Introduction to biological, social, political, and economic facets of conservation biology. Emphasizes evaluation of how best to maintain and restore biodiversity through management of populations and ecosystems. Topics include mass extinctions, global change, loss and degradation of habitat, and over exploitation of biological resources.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring

FW 3500 - Forest Recreation
The course will review construction, use, maintenance, and management of forest recreation facilities that support non-motorized, and/or motorized uses. Field trips will include visits to a number of high-quality recreation locations to evaluate layout, design, and forest management. Assessment of forest recreation opportunities and potential conflicts will be covered.
Credits: 3.0
Lec-Rec-Lab: (2-0-3)
Semesters Offered: Spring

FW 3510 - Outdoor Recreation and Tourism
This class includes background on Americans and leisure; overview of primary providers of recreation opportunities in the US; management of outdoor recreation opportunities, measuring and valuing outdoor recreation and tourism; outdoor recreation and tourism opportunities in the Great Lakes region.
Credits: 3.0
Lec-Rec-Lab: (2-1-0)
Semesters Offered: Spring

FW 3540 - An Introduction to Geographic Information Systems for Natural Resource Management
The fundamentals of GIS and its application to natural resource management. Spatial data, its uses and limitations are evaluated. Students work extensively with the ARCGIS software package.
Credits: 4.0
Lec-Rec-Lab: (3-0-3)
Semesters Offered: Spring
Pre-Requisite(s): MA 2710(C) or MA 2720(C) or MA 3710(C) or ENVE 3502(C)

FW 3600 - Wildlife Habitat
Understand the ecological basis for management of forest wildlife and how forest management influences wildlife populations. Laboratory introduces techniques in wildlife research and management, especially methods of habitat analysis.
Credits: 3.0
Lec-Rec-Lab: (2-0-3)
Semesters Offered: Fall, Summer
Restrictions: Must be enrolled in one of the following Major(s): Forestry, Wildlife Ecology & Mgmt, App Ecol & Environ Sci; May not be enrolled in one of the following Class(es): Freshman

FW 3610 - Ornithology
An ecological and evolutionary approach to the study of birds. Topics include behavioral, anatomical, and physiological adaptations to flight, life history, mating systems, migration, communication and conservation. Laboratory emphasizes identification and experimental use of birds as model organisms.
Credits: 4.0
Lec-Rec-Lab: (3-0-3)
Semesters Offered: Spring
Pre-Requisite(s): BL 1040 or BL 1020

FW 3620 - Field Ornithology
An introduction to field techniques and identification. Weekend trip to Whitefish Point Bird Observatory during spring migration and field note taking.
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Summer

FW 3640 - Aquatic Ecosystems
Students will be introduced to aspects of lake and stream ecosystems. Field trips will focus on sampling abiotic and biotic characteristics of aquatic ecosystems especially in regard to land use and management and conservation.
Credits: 2.0
Lec-Rec-Lab: (1-0-3)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Class(es): Freshman
FW 3760 - Human Dimensions of Natural Resources
Uses sociological concepts to cover facets of human relationships to natural resources, including human values, beliefs, and attitudes regarding the environment; rural resource-dependent communities; natural resource professions and expert knowledge; and the history of American perspectives on the environment.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

FW 3800 - Insect Ecology
Insects are widespread and diverse components of terrestrial and aquatic ecosystems. This course will consider aspects of insect ecology, including biodiversity and conservation of insects, the effects of biotic and abiotic factors on insect populations, and the trophic diversity of insects.
Credits: 2.0
Lec-Rec-Lab: (1-1-0)
Semesters Offered: Fall, Summer
Restrictions: Must be enrolled in one of the following Major(s): Wildlife Ecology & Mgmt, App Ecol & Environ Sci

FW 3840 - Forest Health
Drawing on examples from the Great Lakes region, and other parts of North America, this course will consider which type of insects and pathogens attack our trees and forests, how they interact with each other, and what tools we can use to effectively reduce their negative impacts of forest pests.
Credits: 3.0
Lec-Rec-Lab: (1-1-3)
Semesters Offered: Fall, Summer
Restrictions: Must be enrolled in one of the following Major(s): Forestry, Wildlife Ecology & Mgmt, App Ecol & Environ Sci
Pre-Requisite(s): FW 3020

FW 4000 - Professional Experience Program
Students create oral/written report based on paid or volunteered work or field experience in natural resources.
Credits: 1.0; Repeatable to a Max of 4
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required

FW 4080 - Forest Finance & Economics
The course will use a process-based approach to present the physical, hydrological, geomorphological and water quality of forested watersheds. Course critical evaluation of model designs, outputs, uses in silvicultural decision-making, and forest to landscape management and planning.
Credits: 2.0
Lec-Rec-Lab: (2-0-3)
Semesters Offered: Fall
Pre-Requisite(s): FW 3010 and FW 3012 and FW 3540(C)

FW 4100 - Forest Resource Management
Methods of organizing forest properties for sustainability and multiple-use management using operations research methods, particularly linear programming, for selecting preferred options. Emphasizes developing an understanding of the strengths and weaknesses of the models used. Discusses single- and multiple-use land management formulations.
Credits: 3.0
Lec-Rec-Lab: (2-0-3)
Semesters Offered: Spring

FW 4110 - Stand & Forest Modeling
Use of models that simulate tree, stand, and forest development. Emphasis on critical evaluation of model designs, outputs, uses in silvicultural decision-making, and forest to landscape management and planning.
Credits: 2.0
Lec-Rec-Lab: (1-0-2)

FW 4140 - Stand & Forest Modeling
Use of models that simulate tree, stand, and forest development. Emphasis on critical evaluation of model designs, outputs, uses in silvicultural decision-making, and forest to landscape management and planning.
Credits: 2.0
Lec-Rec-Lab: (1-0-2)

FW 4150 - Forest Resource Management
Methods of organizing forest properties for sustainability and multiple-use management using operations research methods, particularly linear programming, for selecting preferred options. Emphasizes developing an understanding of the strengths and weaknesses of the models used. Discusses single- and multiple-use land management formulations.
Credits: 3.0
Lec-Rec-Lab: (2-0-3)
Semesters Offered: Spring

FW 4170 - Consulting Forestry
For students who are considering consulting forestry as a career. Covers issues specific to working with private landowners, stewardship plan writing, choosing a business entity, marketing, taxes, income/expenses, insurance, timber sale administration, and resolving landowner disputes.
Credits: 2.0
Lec-Rec-Lab: (2-0-0)
Semesters Offered: Spring

FW 4220 - Wetlands
Students have hands-on roles in the routine greenhouse culture, such as choosing a business entity, marketing, taxes, income/expenses, insurance, timber sale administration, and resolving landowner disputes.
Credits: 3.0
Lec-Rec-Lab: (3-0-3)
Semesters Offered: Fall

FW 4240 - Mammalogy
Describes functions and values of individual wetland types. Presents management of wetlands and laws governing wetlands. Labs concentrate on field techniques used to assess specific plant, animal, soil, and hydrological characteristics of wetlands.
Credits: 4.0
Lec-Rec-Lab: (3-0-3)
Semesters Offered: Fall

FW 4250 - The Wolves and Moose of Isle Royale
Wolves and moose have been studied for 50 years on Isle Royale, a wilderness island in Lake Superior. The instructor leads this research and uses the research to explain predation, population dynamics, conservation genetics, and other ecological principles.
Credits: 2.0
Lec-Rec-Lab: (1-1-0)

FW 4370 - Forest Landscape Hydrology
This course explores how genetic variation and its loss affect the ability of natural populations to adapt to changing environments. We will focus on the cycling of water, carbon, and nutrients within the context of global change.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring

FW 4380 - Insect Ecology
Insects are widespread and diverse components of terrestrial and aquatic ecosystems. This course will consider aspects of insect ecology, including biodiversity and conservation of insects, the effects of biotic and abiotic factors on insect populations, and the trophic diversity of insects.
Credits: 2.0
Lec-Rec-Lab: (1-1-0)
Semesters Offered: Fall, Summer
Restrictions: Must be enrolled in one of the following Major(s): Forestry, Wildlife Ecology & Mgmt, App Ecol & Environ Sci
Pre-Requisite(s): FW 3020

FW 4490 - Programming Skills for Bioinformatics
Students will learn computer programming skills in Perl for processing genomic sequences and gene expression data and become familiar with various bioinformatics resources. The students will use real sequence and expression sequences and gene expression data and become familiar with various bioinformatics resources.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2015-2016 academic year

FW 4500 - Professional Experience Program
Students create oral/written report based on paid or volunteered work or field experience in natural resources.
Credits: 1.0; Repeatable to a Max of 4
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required

FW 4550 - Forest Management
This course explores how genetic variation and its loss affect the ability of natural populations to adapt to changing environments. The relevance for the long-term conservation of animal and plant populations is highlighted.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring

FW 4600 - Wetlands
Describes functions and values of individual wetland types. Presents management of wetlands and laws governing wetlands. Labs concentrate on field techniques used to assess specific plant, animal, soil, and hydrological characteristics of wetlands.
Credits: 4.0
Lec-Rec-Lab: (3-0-3)
Semesters Offered: Fall

FW 4620 - Population Ecology
Covers the classification, structure, and natural history of mammals, including physiological, behavioral, and ecological adaptations. Through laboratory and fieldwork, emphasizes field techniques and the distribution and identification of mammals, especially those species found in the western Great Lakes.
Credits: 4.0
Lec-Rec-Lab: (3-0-3)
Semesters Offered: Fall

FW 4700 - Introducation to Wildland Fire
An introduction to wildland fire based on an understanding of fuel properties, fire behavior, ecological effects and management.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)

FW 4730 - Forest Landscape Hydrology
The course will use a process-based approach to present the physical hydrology, geomorphology and water quality of forested watersheds. Course focuses on the interaction between watershed processes and forest management.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring

FW 4740 - Forest Landscape Hydrology
The course will use a process-based approach to present the physical hydrology, geomorphology and water quality of forested watersheds. Course focuses on the interaction between watershed processes and forest management.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring

FW 4800 - Forest Finance & Economics
The course will use a process-based approach to present the physical hydrology, geomorphology and water quality of forested watersheds. Course focuses on the interaction between watershed processes and forest management.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
FW 4380 - Landscape Ecology and Planning
Basic principles of landscape ecology, including pattern, process, and scale. Students will learn how to use quantitative tools to study landscape-scale patterns and processes, and how to apply these principles and tools to conservation, resource management, and planning issues.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

FW 4400 - Urban Forestry
Urban forestry is the science and art of managing natural resources in communities. It focuses on maximizing the wide range of economic, environmental, and social benefits associated with trees and urban greenspaces while minimizing maintenance costs and reducing tree-related risks.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring

FW 4401 - Urban Forestry Lab
The urban forestry field lab is a two-day tour held in Chicago for students to interact with and learn from professionals in the green industry, arboriculture, and urban forestry. It coincides with the Midwest Urban Tree Care Forum in mid-April.
Credits: 1.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Spring

FW 4500 - Independent Study
Guided study or research on an approved forest resource topic with a chosen faculty member.
Credits: variable to 7.0; Repeatable to a Max of 7
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required

FW 4540 - Remote Sensing of the Environment
Overview of remote sensing principles and concepts. Topics include camera and digital sensor arrays, various types of imagery, structure of digital data, spectral reflectance curves, applications/case studies and introduction to digital image processing.
Credits: 3.0
Lec-Rec-Lab: (2-1-0)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

FW 4541 - Remote Sensing of the Environment Lab
Offers students hands-on experience applying remote sensing principles and concepts to real world issues in resource management and ecosystem science. Various types of imagery and other remotely sensed data are presented along with relevant theory and analysis methods.
Credits: 1.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Fall

FW 4545 - Map Design with GIS
Principles of making maps, from traditional to advanced visualization techniques, that convey information which is useful in decision making at many levels. Focus will be on creating maps using GIS software and digital data. A working knowledge of ArcMap is required.
Credits: 2.0
Lec-Rec-Lab: (1-0-3)
Semesters Offered: Spring - Offered alternate years beginning with the 2015-2016 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): FW 3540 or FW 5550

FW 4610 - Wildlife Ecology
Covers the ecological basis for management of wildlife, including biological and sociological factors that influence management.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): BL 3400(C) or FW 3020(C)

FW 4620 - Herpetology
The biology of amphibians and reptiles, including evolution, zoogeography, ecology, behavior and physiology.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Pre-Requisite(s): BL 1040 or BL 1020

FW 4810 - Integrated Resource Assessment
Provides a capstone experience by integrating techniques from many of the forestry, applied ecology, wildlife ecology, and management core courses. Covers multi-resource inventory of forested landscapes evaluation of forest parameters and the development of management plans for various natural resource alternatives.
Credits: 4.0
Lec-Rec-Lab: (0-2-4)
Semesters Offered: Fall
Pre-Requisite(s): FW 3190

FW 4840 - Senior Research Thesis
An independent study or research project on an approved topic in Forestry, Applied Ecology and Environmental Sciences, or Wildlife Ecology and Management, developed under the guidance of a faculty member. Available only to students in their graduating year.
Credits: 4.0
Lec-Rec-Lab: (0-4-0)
Semesters Offered: Fall, Spring
Restrictions: Permission of instructor required; Must be enrolled in one of the following Class(es): Senior
Pre-Requisite(s): FW 3190

Geological & Mining Engineering & Sciences

GE 1100 - Geological Engineering and Sciences Orientation
Introduction to geosciences as a profession, including discussions of career opportunities and geoscience programs. Earth materials and the earth's processes are also introduced. Includes frequent field trips. Intended for freshman or sophomore students in geological engineering, geology, applied geophysics, hydrology, geotechnics, earth science teaching, or any other geoscience program.
Credits: 1.0; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Fall

GE 2000 - Understanding the Earth
Introduction to materials and processes that shape the earth we live on. Lecture and laboratories acquaint students with minerals, rocks, earth resources, weathering, geologic time, landslides, groundwater, streams, shorelines, deserts, glaciers, geologic structures, earthquakes, plate tectonics, and the dynamics of the earth's crust, mantle, and core.
Credits: 3.0
Lec-Rec-Lab: (2-0-3)
Semesters Offered: Fall, Spring, Summer

GE 2020 - Introduction to Mining Engineering and Mining Methods
Learn how various mining components, from prospecting to financing to reclamation, fit together. Includes advantages and drawbacks of different mining methods and their selection. Introduces ethics and professional development. Use of basic computer and mine design software.
Credits: 4.0
Lec-Rec-Lab: (4-0-0)
Semesters Offered: Fall, Spring - Offered alternate years beginning with the 2005-2006 academic year

GE 2100 - Environmental Geology
Introduction and study of current environmental issues related to the earth sciences. Covers major topics such as volcanism, earthquakes, shoreline erosion, and pollution of groundwater as multi-week modules with associated labs, lectures, and field projects.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring

GE 2300 - Mineral Science
Introduction to the study of minerals including chemical composition, crystal structure, physical properties, identification, and controls on and environments of formation. Laboratory focuses on hand specimen identification of minerals and includes introduction to X-ray diffraction and SEM mineral analysis techniques.
Credits: 3.0
Lec-Rec-Lab: (2-0-3)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Class(es): Sophomore
Pre-Requisite(s): CH 1000 or CH 1112 or (CH 1150 and CH 1151)
GE 2310 - Introduction to Petrology
Identification, physical properties, chemical composition, occurrence, and origin of the important types of igneous, sedimentary, and metamorphic rocks. Laboratory includes hand specimen description and identification of rocks.
Credits: 3.0
Lec-Rec-Lab: (2-0-3)
Semesters Offered: Spring
Pre-Requisite(s): GE 2300

GE 2500 - Introduction to Oceanography
Effect of waves, tides, currents, natural hazards along shorelines, and air-sea interactions on the climate.
Credits: 3.0
Lec-Rec-Lab: (2-0-3)
Semesters Offered: Spring

GE 2640 - Atmospheric Observations and Meteorology
Introduction to fundamentals of atmospheric science and meteorology through direct observations of the atmosphere.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2002-2003 academic year

GE 2900 - Geology of the National Parks: Field Experience
Two-week, field-based course taught in national parks Focuses on making and recording observations, developing and testing hypotheses, integrating information from a variety of sources, and presenting results in a variety of formats. Lab fee costs dependent on location.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Summer
Restrictions: Permission of instructor required

GE 3040 - Fundamentals of Applied and Environmental Geophysics
An introduction to geophysical used in applied and environmental geophysics concentrating on the fundamentals of data reduction and interpretation. This course is not only pertinent for the practicing geoscientist but also for environmental engineers, civil engineers, and others interested in learning how physics can be used to investigate Earth's substance.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Pre-Requisite(s): PH 2200

GE 3050 - Structural Geology
Rock structures and regional settings resulting from the application of deforming forces, including the geometry, orientation, and mechanics of folds, foliations, lineations, faults ad joints, and structures in orogenic belts.
Credits: 4.0
Lec-Rec-Lab: (3-0-2)
Semesters Offered: Spring
Pre-Requisite(s): GE 2000

GE 3100 - Depositional Systems
Introduction to sedimentary processes and their products. Investigates the physical processes controlling sedimentation along with principles of correlation and interpretation of strata. Focuses on interpreting sedimentary rocks as a record of climate, sea-level and tectonic change.
Credits: 3.0
Lec-Rec-Lab: (2-0-3)
Semesters Offered: Fall
Pre-Requisite(s): GE 2000 and GE 2310

GE 3200 - Geochemistry
Introduction to elements of modern geochemistry including aqueous solutions, isotopes, age dating, etc. Emphasizes concepts and quantitative methods. Teaches principles of thermodynamics and phase equilibria from an introductory perspective as they pertain to geologic systems.
Credits: 3.0
Lec-Rec-Lab: (2-1-0)
Semesters Offered: Spring
Pre-Requisite(s): CH 1150 and CH 1151

GE 3250 - Computational Geosciences
Introduction to quantitative analysis and display of geologic data using R/Matlab, covering basic R/Matlab syntax and programming, and analysis of one-dimensional (e.g. time series) and two-dimensional datasets (i.e. spatial data). Techniques are applied to geological datasets.
Credits: 3.0
Lec-Rec-Lab: (2-0-1)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): MA 1160 or MA 1181

GE 3320 - Earth History
This course covers the history of the Earth from 4.5 billion years to the present. Plate tectonics is the organizing theme with emphasis on recognizing and evaluating the evidence for the major reorganizations of the Earth’s crust.
Credits: 3.0
Lec-Rec-Lab: (2-0-3)
Semesters Offered: Fall
Pre-Requisite(s): GE 2000 or GE 2100

GE 3400 - Drilling and Blasting
Rock penetration and fragmentation methods to include boring, cutting, drilling, and blasting techniques. Design of surface and underground blasting rounds. Formulation of design criteria to minimize the adverse effects of blasting. Field demonstration in the design, monitoring, and evaluation of blasts.
Credits: 3.0
Lec-Rec-Lab: (2-0-2)
Semesters Offered: Fall, Spring - Offered alternate years beginning with the 2006-2007 academic year
Pre-Requisite(s): GE 2020 and PH 2100

GE 3410 - Mine Safety & Health Cert
Principles of health and safety in mine practice, hazard recognition, and preventative and corrective actions.
Credits: 1.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Summer

GE 3670 - Oceanographic Science
A multidisciplinary integration of the core sub-disciplines of oceanography (physics, chemistry, biology, and geology). Hands on laboratory introducing oceanographic observational techniques and analysis. Upper-level science course designed for students in a variety of majors.
Credits: 3.0
Lec-Rec-Lab: (2-0-2)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior

GE 3820 - Mechanics of Rock Materials
Analysis of stress and strain in rock for scientists and engineers. Topics range from Mohr circles for stress, incremental strain and finite strain through stress and strain tensors, and constitutive equations, with applications in rock slope stability. Previous coursework in tensors not required.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Pre-Requisite(s): GE 3050

GE 3850 - Geohydrology
Geologic and hydrologic factors controlling the occurrence, movement, and development of subsurface water. Quantitative methods for analyzing groundwater systems are introduced.
Credits: 3.0
Lec-Rec-Lab: (2-0-3)
Semesters Offered: Fall

GE 3860 - Engineering Geology and Geoinformatics
Engineering geology relates the geologic factors with the location, design, construction, and maintenance of engineering projects and ensures they are accounted. Students will also be introduced to the fundamental concepts and components of geographic information systems (GIS) for engineering.
Credits: 3.0
Lec-Rec-Lab: (2-0-1)
Semesters Offered: Fall - Offered alternate years beginning with the 2015-2016 academic year
Pre-Requisite(s): GE 2000 or GE 2100 and (GE 3050 or ENG 2120 or MEEM 2150)

GE 3900 - Field Geophysics
Introduction to field geophysical techniques including basic land surveying. Emphasizes the recording, reduction, presentation, and interpretation of gravity, magnetic, electrical, seismic, and electromagnetic data as well as the proper use, care, and calibration of equipment used to collect the data. Requires report writing. Students must provide their own transportation.
Credits: 5.0
Lec-Rec-Lab: (0-0-15)
Semesters Offered: Summer
Restrictions: Permission of department required
Pre-Requisite(s): GE 3040

GE 3910 - Field Geology with Engineering Applications
Introduction to methods and problems of field geology, interpretation of field relationships, and engineering site investigation. Field areas are located in northern Michigan. Requires geological and/or engineering report and memo writing.
Credits: 5.0
Lec-Rec-Lab: (0-0-15)
Semesters Offered: Summer
Restrictions: Permission of department required
Pre-Requisite(s): GE 2000 and GE 2310 and GE 3050
GE 3915 - Introduction to Field Geology  
An introduction to geologic field mapping and site investigations. Requires geological and/or engineering report and memo writing.  
Credits: 3.0  
Lec-Rec-Lab: (0-0-9)  
Semesters Offered: Summer  
Restrictions: May not be enrolled in one of the following Major(s): Geological Engineering, Applied Geophysics  
Pre-Requisite(s): GE 2000 and GE 2310 and GE 3050  

GE 3920 - Geologic Field Excursion  
A geological field excursion of one week or more to areas of outstanding interest to geologists.  
Credits: variable to 6.0; Repeatable to a Max of 6  
Semesters Offered: On Demand  

GE 4000 - Earth Science Teaching Experience  
Development of earth science teaching skills through assisting in instruction in a geology course laboratory. Students gain experience in organizing, preparing, and presenting earth science topics and answering questions.  
Credits: variable to 3.0; Repeatable to a Max of 3  
Semesters Offered: On Demand  

GE 4100 - Geomorphology and Glacial Geology  
The study of the processes, including fluvial, glacial, wind, mass movement, and wave action, shaping the earth's surface by erosion and deposition of geologic materials. Emphasizes the role of past and present climate. Field trips are a major component.  
Credits: 4.0  
Lec-Rec-Lab: (3-0-3)  
Semesters Offered: Fall - Offered alternate years beginning with the 2003-2004 academic year  
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore  
Pre-Requisite(s): GE 2000  

GE 4150 - Natural Hazards  
This course focuses on current mitigation agencies and warning systems, case studies of successes and failures in hazard mitigation, and technical tools for hazard study and mitigation such as satellite remote sensing and GIS.  
Credits: 3.0  
Lec-Rec-Lab: (2-0-3)  
Semesters Offered: Fall  
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore  
Pre-Requisite(s): GE 2000 or GE 2100  

GE 4180 - Volcanology  
Volcanoes and how they work. Volcanic eruption styles and products, their recognition, and significance. Volcanic hazards, volcano monitoring and impacts of volcanism on the environment, climate and society. Applies chemistry, physics, and fluid mechanics in a volcanological context.  
Credits: 3.0  
Lec-Rec-Lab: (3-0-0)  
Semesters Offered: Fall  
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior  
Pre-Requisite(s): GE 2000 and (MA 1160 or MA 1161)  

GE 4250 - Fundamentals of Remote Sensing  
This course focuses on the basic physics behind above- surface remote sensing and remote sensing systems. Topics covered include: properties of the atmosphere, absorption and scattering of electromagnetic radiation, instrument design, data acquisition and processing, validation, and basic applications.  
Credits: 3.0  
Lec-Rec-Lab: (2-1-0)  
Semesters Offered: Spring  
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore  
Pre-Requisite(s): PH 2200 and MA 2160  

GE 4300 - Materials Handling  
Surface and underground materials handling methods. Selection and performance analysis of materials handling equipment. Computer applications.  
Credits: 3.0  
Lec-Rec-Lab: (3-0-0)  
Semesters Offered: On Demand  
Pre-Requisite(s): PH 2100  

GE 4500 - Plate Tectonics and Global Geophysics  
Plate tectonics and the internal structure of the earth using information from seismology, geomagnetism, gravity, and heat flow.  
Credits: 3.0  
Lec-Rec-Lab: (0-3-0)  
Semesters Offered: Fall  
Pre-Requisite(s): MA 3160 and PH 2200 and GE 2000  

GE 4504 - Air Quality Engineering and Science  
Overview of air quality regulation in the U.S. and world, including basic concepts of atmospheric chemistry and transport; fugitive, point, and air emissions; principles and tradeoffs of operation and design of air pollution control systems; and application of air quality models.  
Credits: 3.0  
Lec-Rec-Lab: (0-3-0)  
Semesters Offered: Fall  
Pre-Requisite(s): ENVE 3501 or ENVE 3503  

GE 4530 - Planetary Geology & Geophysics  
Geological, geophysical, and geochemical processes in the Solar System are examined. Topics include the formation and evolution of the Solar System, planetary surface processes and water distribution, impact structures, composition, structure, and dynamics of planetary interiors, geophysical exploration of planets.  
Credits: 3.0  
Lec-Rec-Lab: (3-0-0)  
Semesters Offered: Fall  
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore  
Pre-Requisite(s): GE 2000 and PH 2200 and MA 2160  

GE 4560 - Earthquake Seismology  
Course covers fundamentals of the physics of earthquakes and seismic energy propagation, and seismic methods to determine Earth structure. Emphasis is placed on natural source techniques, with extension to exploration applications. Weekly labs apply techniques.  
Credits: 3.0  
Lec-Rec-Lab: (2-0-2)  
Semesters Offered: Fall  
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore  
Pre-Requisite(s): GE 3050 and PH 2100 and MA 3160  

GE 4600 - Reflection Seismology  
Principles of reflection seismic techniques, including theoretical background and application, and hands-on computer projects. Included are acquisition, data processing, and 2D/3D data interpretation. Students conduct projects using actual commercial-quality seismic data.  
Credits: 3.0  
Lec-Rec-Lab: (2-1-0)  
Semesters Offered: Spring  
Pre-Requisite(s): GE 3040  

GE 4610 - Formation Evaluation and Petroleum Engineering  
Principles and practice of formation evaluation, primarily through analysis of well log and the principles and practice of petroleum engineering. Emphasizes reservoir engineering and simulation. Students conduct projects using actual field data. A three-day field trip is required.  
Credits: 3.0  
Lec-Rec-Lab: (2-1-0)  
Semesters Offered: Fall, Spring  

GE 4620 - Energy Economics  
Introduction to the institutional, technical, and economic issues of the production and use of energy resources, including petroleum, natural gas, coal, nuclear, electric utilities, and alternative energy sources. Applies economic analysis to industrial and policy problems of the supply, distribution, and use of energy resources, including environmental and social consequences.  
Credits: 3.0  
Lec-Rec-Lab: (3-0-0)  
Semesters Offered: Spring  
Pre-Requisite(s): EC 2001 or EC 3002 or EC 3003  

GE 4630 - Mineral Industry Economics  
Studies the role of minerals and metals in society and the economics of their use. Applies economic principles to examine the supply, demand, markets, and foreign trade for important minerals and metals. Examines the effect of government policies on the minerals industries. Requires a technical report.  
Credits: 3.0  
Lec-Rec-Lab: (3-0-0)  
Semesters Offered: Fall, Spring - Offered alternate years beginning with the 2009-2010 academic year  
Pre-Requisite(s): EC 2001 and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)  

GE 4640 - Fundamentals of Atmospheric Science  
Fundamental principles of atmospheric science, including thermodynamics, aerosol and cloud physics, radiative transfer, and atmospheric dynamics.  
Credits: 3.0  
Lec-Rec-Lab: (3-0-0)  
Semesters Offered: Fall - Offered alternate years beginning with the 2013-2014 academic year  
Pre-Requisite(s): (PH 2200 or PH 2260) and (PH 1360 or PH 2300) and MA 3160 and (MA 3520 or MA 3521 or MA 3530 or MA 3560)
GE 4670 - Aquatic Remote Sensing
Overview of remote sensing techniques used to observe aquatic systems. Integrative approach to physical and biogeochemical remotely sensed properties emphasized from the perspective of oceanographic phenomena observed with examples/applications to takes. Imagery processing/interpretation utilizing space agency processing software and MATLAB.
Credits: 3.0
Lec-Rec-Lab: (2-0-2)
Semesters Offered: Fall
Pre-Requirement(s): PH 1200 and (CH 1150 or GE 2000 or BL 1010 or BL 1040)

GE 4700 - Geologic Mapping of Remote Terrain
An introduction to the use of GIS (Geographic Information Systems) in geologic mapping. Uses remotely acquired data (e.g. Landsat) to produce geologic maps, cross sections, and make measurements such as strike and dip. Students work with both public domain programs (QGIS) and commercial packages (Arc Map) and emphasize the GIS aspects.
Credits: 3.0
Lec-Rec-Lab: (0-2-1)
Semesters Offered: Spring

GE 4760 - Geology and Exploration for Mineral Deposits
Geology, geologic evaluation, and exploration for mineral resources with emphasis on metals. Course covers geologic characteristics of a variety of classes of mineral deposits, design of exploration programs, design of drilling programs, concepts of resource estimation, and reporting requirements. Laboratory includes study of specimens from specific localities and simulated subsurface exploration.
Credits: 3.0
Lec-Rec-Lab: (2-0-3)
Semesters Offered: Fall
Pre-Requirement(s): GE 2310 and GE 3050 and GE 3910

GE 4800 - Groundwater Engineering
Application of hydrogeology principles to design water-well supplies, site investigations, and subsurface remediation systems.
Credits: 3.0
Lec-Rec-Lab: (0-2-3)
Semesters Offered: On Demand
Pre-Requirement(s): GE 3850

GE 4860 - Computer Methods for Slope Stability and Geomechanics
Computer methods for the design problems encountered in geomechanics. Applications to be selected from slope stability, earth retention systems, and seepage. Students will be introduced to limit equilibrium and finite element analysis through theory and computational labs.
Credits: 3.0
Lec-Rec-Lab: (2-0-3)
Semesters Offered: Spring
Pre-Requirement(s): GE 2000 or GE 2100 and (MEEM 2150 or ENG 2120) and ENG 3300

GE 4900 - Geological Engineering Design Project I
Capstone geological engineering design course focusing on a realistic, complex, open-ended geological engineering problem. Project includes technical design, economic analysis, environmental impacts, and regulations. Report writing required. (Senior project ready as defined by major substitutes for prerequisites)
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

GE 4910 - Geological Engineering Design Project II
Continuation of GE4900. Capstone geological engineering design course focusing on a realistic, complex, open-ended geological engineering problem. Project includes technical design, economic analysis, environmental impacts, and regulations. Report writing required. (Senior project ready as defined by major substitutes for prerequisites)
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior
Pre-Requirement(s): GE 4900

GE 4916 - Field Geology in East and South Africa
Introduction to methods and problems of field geology. Data gathering and interpretation of field relationships using Brunton, GPS, Landsat, etc. in East Africa. Requires geological report and digital maps.
Credits: 0.0
Lec-Rec-Lab: (0-0-18)
Semesters Offered: Spring, Summer
Restrictions: Permission of instructor required
Pre-Requirement(s): GE 3050

GE 4930 - Special Topics in Geological Engineering
Study and discussion of geological engineering topics.
Credits: variable to 5.0; Repeatable to a Max of 10
Semesters Offered: On Demand
Restrictions: Permission of instructor required

GE 4931 - Special Topics in Geology
Study and discussion of geology topics.
Credits: variable to 5.0; Repeatable to a Max of 10
Semesters Offered: On Demand
Restrictions: Permission of instructor required

GE 4932 - Special Topics in Mineralogy
The study of special topics in mineralogy using the Seaman Mineral Museum.
Credits: variable to 5.0; Repeatable to a Max of 10
Semesters Offered: On Demand
Restrictions: Permission of instructor required
Pre-Requirement(s): GE 2300

GE 4933 - Special Topics in Geophysics
Study and discussion of geophysics topics.
Credits: variable to 5.0; Repeatable to a Max of 10
Semesters Offered: On Demand
Restrictions: Permission of instructor required

GE 4934 - Special Topics in Mining Engineering
Study and discussion of topics in mining engineering not included in regular undergraduate courses.
Credits: variable to 5.0; Repeatable to a Max of 10
Semesters Offered: On Demand

GE 4961 - Independent Geology Research Project
Approved literature, laboratory, and/or field geology research problem originated by the student or assigned by the instructor. A final report is required.
Credits: variable to 9.0; Repeatable to a Max of 9
Semesters Offered: On Demand
Restrictions: Permission of instructor required. May not be enrolled in one of the following Class(es): Freshman, Sophomore

GE 4962 - Independent Geophysics Research Project
Approved literature, laboratory, and/or field geophysics research problem originated by the student or assigned by the instructor. A final report is required.
Credits: variable to 9.0; Repeatable to a Max of 9
Semesters Offered: On Demand
Restrictions: Permission of instructor required. May not be enrolled in one of the following Class(es): Freshman, Sophomore

GE 4970 - Special Topics in Global Environment Change
Course will focus on emerging topics on global environment change including changes in atmospheric composition and air quality, air pollution meteorology, extreme meteorological events, and ocean chemistry. Anthropogenic contributions to these changes will be presented and analyzed. Students will work on projects based on historical records from multiple datasets to evaluate and appreciate the long-term changes in the global environment and better understand the perturbations due to human activities.
Credits: 3.0; Repeatable to a Max of 6
Lec-Rec-Lab: (2-1-0)
Semesters Offered: Fall, Spring

GE 4990 - Geological Engineering Final Project
Approved literature, laboratory, and/or field geology research problem originated by the student or assigned by the instructor. A final report is required.
Credits: 3.0; Repeatable to a Max of 6
Semesters Offered: Fall, Spring
Pre-Requirement(s): GE 4900

HU 0110 - Undergraduate Student Coaching
Schedule weekly appointments with a writing coach to strengthen writing and reading effectiveness in any course except Composition. Specialized assistance available to students who speak English as a Second Language, students who have learning disabilities and students who are undergraduate writing coaches. Credits do not count toward graduation.
Credits: 0.0; May be repeated
Semesters Offered: Fall, Spring, Summer

HU 0122 - Global Issues Study Team
Students who are enrolled in Global Issues (UN1025) may sign up for a study team led by a writing center coach. Teams meet twice weekly. The meetings address the challenges of the Global Issues course as well as develop students' effectiveness working in teams. Strongly recommended for students with English/Reading ACT of 20 or below. Credits do not count toward graduation.
Credits: 0.0; May be repeated
Semesters Offered: Fall, Spring, Summer
Co-Requirement(s): UN 1025

Humanities

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HU 0123 - Composition Coaching
Scheduled weekly appointment with a writing coach to improve writing and reading effectiveness in Composition (UN1015). Strongly recommended for students with English ACT of 20 or below. Credits do not count toward graduation.
Credits: 0.0; May be repeated
Semesters Offered: Fall, Spring, Summer
Co-Requisite(s): UN 1015

HU 0124 - Graduate Student Coaching
Scheduled weekly appointment with a writing coach to improve writing and reading effectiveness in graduate courses and to address the challenges of writing theses and dissertations. Credits do not count toward graduation.
Credits: 0.0; May be repeated
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate

HU 0125 - Int'l GTA Assistance Program
International graduate students can enroll in HU0125 to work on cultural differences in presentation skills and to practice speaking instructional English. These students will meet weekly in group and individual settings to improve their facility as speakers of English. Credits do not count toward graduation.
Credits: 0.0; May be repeated
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate

HU 2130 - Introduction to Rhetoric
Focuses on historical origins, cultural adaptations, and contemporary relevance of rhetorical traditions.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring

HU 2201 - Level I-A Chinese Language and Culture
Introduction to basic Chinese grammar, vocabulary, and idiomatic expressions, designed to help students acquire the basics of oral and written Chinese. Includes study of contemporary Chinese culture.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Senior

HU 2202 - Level I-B Chinese Language and Culture
Further study of Chinese grammar, vocabulary, and idioms with emphasis on conversation and communicative strategies. Includes continued study of Chinese culture.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Senior

HU 2241 - Level I-A Less Commonly Taught Languages
Introduction to basic grammar, vocabulary, and idioms, designed to help students acquire the basics of oral and written communication. Includes study of cultures in which the language is spoken.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Pre-Requisite(s): HU 2201 or Language Placement Chinese >= 100

HU 2242 - Level I-B Less Commonly Taught Languages
Further study of grammar, vocabulary, and idioms with emphasis on conversation and communicative strategies. Includes continued study of cultures in which the language is spoken.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Pre-Requisite(s): HU 2241

HU 2271 - Level I-A French Language and Culture
Introduction to basic French grammar, vocabulary, and idioms designed to help students acquire the basics of oral and written French. Includes study of contemporary French-speaking cultures.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Restrictions: May not be enrolled in one of the following Class(es): Senior

HU 2272 - Level I-B French Language and Culture
Further study of French grammar, vocabulary, and idioms with continued practice of conversation and basic readings in French. Continued study of contemporary French speaking cultures.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): HU 2271 or Language Placement French >= 131

HU 2273 - Transitional Level I French Language and Culture
Intensive study of basic French grammar, vocabulary, and culture. Designed to prepare students with minimum essentials of oral and written French for intermediate and advanced level work. Students completing this course may apply for placement credits.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Pre-Requisite(s): Language Placement French >= 211

HU 2281 - Level I-B German Language and Culture
Further study of the basics of the German language acquainting students with the essentials of oral and written German, and introducing cultures and societies of contemporary German-speaking Europe.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Restrictions: May not be enrolled in one of the following Class(es): Senior

HU 2282 - Level I-B German Language and Culture
Further study of the basics of the German language acquainting students with the essentials of oral and written German, with emphasis on conversational skills. Includes continued discussion of cultures and societies of contemporary German-speaking Europe.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): HU 2281

HU 2291 - Level I-A Spanish Language and Culture
Introduction to basic Spanish grammar, vocabulary, and idioms, designed to help students acquire the basics of oral and written Spanish. Includes study of contemporary Spanish-speaking cultures.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Restrictions: May not be enrolled in one of the following Class(es): Senior

HU 2292 - Level I-B Spanish Language and Culture
Further study of basic Spanish grammar, vocabulary, and idioms with continued practice of conversation and basic readings in Spanish. Continued study of selected Hispanic cultures.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): HU 2291 or Language Placement Spanish >= 131

HU 2293 - Transitional Level I Spanish Language and Culture
Intensive review of basic Spanish grammar, vocabulary, and culture. Designed to prepare students with minimum essentials of oral and written Spanish for intermediate and advanced level work. Students completing this course may apply for placement credit.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): HU 2291 or Language Placement Spanish >= 201

HU 2324 - Introduction to Film
Focuses on film narration and style within social, cultural, and historical contexts. Emphasizes critical engagement with film through discussion, presentations, and written analysis. May include small video production projects and opportunities to interact with filmmakers and industry professionals.
Credits: 3.0
Lec-Rec-Lab: (0-2-3)
Semesters Offered: Fall, Spring

HU 2400 - Introduction to Diversity Studies in the United States
This course provides students with a better understanding of underrepresented populations within the United States by examining the social, cultural, and personal consequences of gender, race, ethnicity, class, sexual orientation, (dis)ability, and other significant identities.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2015-2016 academic year

HU 2500 - Intro to Textual Analysis
This course introduces students to reading strategies, critical vocabularies, and critical writing practices. Individual sections will center on a unifying question or problem, emphasizing attentive reading, critical thinking, and qualitative interpretation of literary texts.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
HU 2503 - Literary Survey A - Periods and Movements
The first of a two part literary survey of transnational or trans-Atlantic traditions that will highlight select historical periods and/or movements. Part A covers the Early Modern period through the eighteenth century, including Shakespeare and Milton.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring

HU 2504 - Literary Survey B - Periods and Movements
The second of a two part literary survey of transnational or trans-Atlantic traditions that will focus on select historical periods and/or movements. Part B covers the nineteenth century through the contemporary moment, with authors from Voltaire to Morrison.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring

HU 2505 - Science, Technology, and Humanities
A survey using literary texts, narrative history, documentary evidence, film, music, and cross-cultural references to contextualize the emergence of scientific, technological, and humanistic developments in the modern era.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring

HU 2510 - Intro to Creative Writing
An introduction to creative writing with readings in contemporary and emerging literatures. Genres covered may include fiction, nonfiction, poetry, and screenplay. This course stresses individual production through process-oriented writing exercises, small group workshops, individual conferences, and creative theory.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2000-2001 academic year

HU 2538 - British Experience in Literature
A survey of selected works of British literature from its origins to the present. Focuses on historical trends in the development of the English language and the cultures of Great Britain.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2016-2017 academic year

HU 2548 - Young Adult Literature
Reading, reflecting on, and responding to age-appropriate adolescent literature. Works include authors from different races, cultures, historical periods, and genders. Discussion may be supplemented with films. Appropriate for students who plan to be parents, community volunteers, and teachers.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall

HU 2600 - Introduction to the Field of Scientific and Technical Communication
An introduction to the history, theory, and practice of scientific and technical communication as preparation for future study.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Major(s): Scientific & Tech Comm (BS), Scientific & Tech Comm (BA)

HU 2623 - Fundamentals of Digital Photography
Explores the history, aesthetics, theory, and practice of photography in the digital environment. Students learn in-depth digital camera and imaging production techniques. Students provide their own digital camera, preferably a digital SLR.
Credits: 3.0
Lec-Rec-Lab: (0-2-3)
Semesters Offered: Summer

HU 2623 - Fundamentals of Digital Imaging
Explores the history, aesthetic, theory, and practice of digital imaging. Students learn production and post-production techniques. Students may provide their own digital SLR camera.
Credits: 3.0
Lec-Rec-Lab: (0-2-3)
Semesters Offered: Spring

HU 2642 - Introduction to Digital Media
Basic principles, practices and implications of digital media communication and production. Provides foundation in tools, techniques and processes through hands-on production, readings, discussion and analysis of contemporary issues related to digital media.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring

HU 2645 - Graphic and Information Design
A computer-intensive introduction to the principles for creating clear, effective graphic communication. Students critique the work of other designers in terms of the work's audience and intended effect, and they construct and critique their own design projects as well.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall

HU 2700 - Introduction to Philosophy
A study of thought representing various traditions such as classical and contemporary philosophy, Eastern and Western religion, and issues in recent science. Some basic concepts of logic are also examined. Emphasizes moral philosophy, including ethical relativism, utilitarianism, and Kantian ethics.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring

HU 2701 - Logic and Critical Thinking
Introduction to everyday reasoning and formal logic. Important goal is to develop skills of argument identification, analysis, and evaluation. Students learn how to symbolize ordinary language statements and arguments and to determine their validity or invalidity using proof and truth-table methods.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand

HU 2702 - Ethical Theory and Moral Problems
An introduction to the major concepts and theories of normative ethics and metaethics and an examination of a variety of issues in applied ethics including poverty and economic justice, lying and truth-telling, euthanasia, sexual conduct, and issues in communication ethics.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Summer

HU 2810 - Research and Writing in Communication
Prepare students to evaluate, design, and conduct research in communication. Develops research-related writing strategies and proficiency.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand

HU 2820 - Communication and Culture
Introduction to the ways that communication creates and maintains culture. Considers a variety of perspectives on the significance of communication. Explores the importance of communication for understanding culture.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall

HU 2830 - Public Speaking & Multimedia
Introduces the fundamentals of public speaking and multimedia applications. Emphasis on speaking/listening competencies in face-to-face and digital environments using online and digital tools.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall

HU 2910 - Language and Mind
Examines how societies use and organize themselves with respect to language. Considers attitudes towards language standardization and dialectal variations within the US based on geography, class, ethnicity, gender, age, etc., and speakers' choices of how they present themselves linguistically.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring

HU 2910 - Language and Mind
Examines how societies use and organize themselves with respect to language. Considers attitudes towards language standardization and dialectal variations within the US based on geography, class, ethnicity, gender, age, etc., and speakers' choices of how they present themselves linguistically.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring

HU 3015 - Advanced Composition
Advanced instruction in composing substantive arguments based on primary and secondary research. Multidisciplinary inquiry-based projects ask students to write for both academic and lay audiences in print and digital forms. Specific research methods, writing technologies, and topics vary by section.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): UN 1015

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HU 3120 - Technical and Professional Communication
A study of written and oral communication in technical and scientific environments; emphasizes audience, writing processes, genres of scientific and technical discourse, visual communication, collaboration, professional responsibility, clear and correct expression. Students write and revise several documents and give oral report(s). Computer intensive.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3130 - Rhetorics of Science and Technology
A study of contemporary theories of rhetoric and their application to interpreting and critiquing various forms of persuasive discourse, especially in science and technology.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3150 - Topics in Literacy Studies
A study of how and why different groups of people use reading and writing differently in varying situations and in varying textual media. Topics may include the various ways texts function and reading is used; the authority of written texts; access to reading and writing to and various textual media. May address social issues, language and cultural differences, gender, race, ethnicity, class, disabilities, age, religion, family and national identity.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3151 - The Rhetoric of Everyday Texts
The examination and production of everyday texts such as social media, image-texts, web pages, signs, museum exhibits, architecture, and fashion in terms of their theoretical, historical, cultural, and technological contexts. Student should expect to produce "everyday texts" of their own as well as write about texts examined in the course.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3201 - Level II-A Chinese Language and Culture
Review and continued study of listening, speaking, reading, and writing in Chinese. Students learn how to communicate in Chinese societies. Includes study of various aspects of the Chinese culture.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Pre-Requisite(s): HU 2202 or Language Placement Chinese >= 201

HU 3202 - Level II-B Chinese Language and Culture
Further study of Chinese language. Includes study of vocabulary, idioms, and sentences structure to improve conversational, reading, and writing abilities. Includes discussion of various aspects of Chinese culture.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Pre-Requisite(s): HU 2201 or Language Placement Chinese >= 301

HU 3204 - Level III Topics in Chinese Literature and Culture
Study of various genres of Chinese literature and of various aspects of Chinese society, emphasizing historical and cultural backgrounds. Conducted primarily in Chinese.
Credits: 3.0; Repeatable to a Max of 6
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Pre-Requisite(s): HU 3202 or Language Placement Chinese >= 401

HU 3241 - Level II A Less Commonly Taught Language and Culture
Review and continued study of listening, speaking, reading, and writing in less commonly taught language. Students learn how to communicate in target culture. Includes study of various aspects of the culture in which the language is used.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Pre-Requisite(s): HU 2242

HU 3242 - Level II B Less Commonly Taught Language and Culture
Further study of less commonly taught language. Includes study of vocabulary, idioms, and sentence structure to improve conversational reading and writing abilities and discussions of various aspects of culture in which the language is used.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Pre-Requisite(s): HU 3241

HU 3253 - World Literatures & Cultures
Comparative approach to world literatures and cultures. May include literary works, critical essays, films, music, and other representations of world culture.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3261 - Topics in Communicating Across Cultures
Examines communication practices and styles across selected cultures and multicultural groups, drawing on an interdisciplinary range of research fields. May address social issues, language and cultural differences, gender, race, ethnicity, class, disabilities, age, religion, family and national identity.
Credits: 3.0; Repeatable to a Max of 6
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3262 - Topics in Francophone Cultures
An introduction to Francophone cultures (in English) in a comparative perspective. Includes a survey of French history and its influence on Francophone societies. Includes study of film and other media and a critical examination of cross-cultural differences between French, Francophone, and U.S. cultures.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): May not be enrolled in one of the following Class(es): Freshman

HU 3263 - Topics in German-Speaking Cultures
An introduction to German-speaking cultures (in English) in a comparative perspective. Includes a survey of Central-European history and its influence on modern-day German-speaking societies through movies, media, and recent technologies, and a critical examination of cross-cultural differences between German and North-American cultures.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): May not be enrolled in one of the following Class(es): Freshman

HU 3264 - Topics in Spanish-Speaking Cultures
An introduction to Spanish-speaking cultures (in English) in comparative historical perspectives. Includes a survey and a critical cross-cultural examination of Latin-American cultures and Spanish-speaking societies (European, Caribbean, and North, Central and South American) through literature, music, film, art, and other media.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): May not be enrolled in one of the following Class(es): Freshman

HU 3265 - Topics in East Asian Cultures
Introduction to the contemporary and traditional cultures of China, Korea, and Japan taught through readings, films, lectures, and discussions. Taught in English.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand

HU 3271 - Level II-A French Language and Culture
Review and continued study of grammar, vocabulary, speaking, listening, reading, and writing in French. Includes written compositions and oral presentations. Cultural focus on several Francophone regions of the world.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): HU 2272 or HU 2273 or Language Placement French >= 331

HU 3272 - Level II-B French Language and Culture
Continued study of grammar, vocabulary, speaking, listening, reading, and writing in French. Includes written compositions, oral presentations, and reading of brief literary texts. Cultural focus on several Francophone regions of the world.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): HU 3271 or Language Placement French >= 421
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
<th>Semester Offered</th>
<th>Credits</th>
<th>Lec-Rec-Lab</th>
<th>Pre-Requisite(s)</th>
<th>Repeatable to a Max of</th>
</tr>
</thead>
<tbody>
<tr>
<td>HU 3273</td>
<td>Level II French Composition and Conversation</td>
<td>Extensive work in the active, creative use of written and oral French. Includes development of communicative strategies, written compositions, and oral presentations in the context of contemporary French-speaking cultures. May include study of film and other media.</td>
<td>Spring</td>
<td>3.0</td>
<td>(0-3-0)</td>
<td>HU 2272 or HU 2273 or Lang Placement French I-A Tran &gt;= 301</td>
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<tr>
<td>HU 3274</td>
<td>Level III Topics in French Literature and Culture</td>
<td>Topics in French literature and its historical and cultural contexts. May include selections from Francophone literature. Conducted in French.</td>
<td>Fall - Offered alternate years beginning with the 2013-2014 academic year</td>
<td>3.0</td>
<td>(0-3-0)</td>
<td>HU 3272 or HU 3273 or Language Placement French &gt;= 501</td>
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</tr>
<tr>
<td>HU 3275</td>
<td>Level III French for Special Purposes</td>
<td>Study of business, technical, and/or scientific discourses in the context of French language and Francophone cultures.</td>
<td>Fall, Spring</td>
<td>3.0</td>
<td>(0-3-0)</td>
<td>HU 2272 or Language Placement German &gt;= 221</td>
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<tr>
<td>HU 3280</td>
<td>Level I-C German Language and Culture</td>
<td>Concluding study of the basics of the German language acquainting students with the essentials of oral and written German, with emphasis on conversational skills. Includes continued discussion of cultures and societies of contemporary German-speaking Europe.</td>
<td>Fall, Spring</td>
<td>3.0</td>
<td>(0-3-0)</td>
<td>HU 3280 or Language Placement German &gt;= 301</td>
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</tr>
<tr>
<td>HU 3282</td>
<td>Level II-B German Language and Culture</td>
<td>Review of the basics of the German language. Includes study of vocabulary, idioms, and sentence structure to improve conversational and reading abilities, and discussion of various aspects of contemporary German culture.</td>
<td>Fall, Spring</td>
<td>3.0</td>
<td>(0-3-0)</td>
<td>HU 3280 or Language Placement German &gt;= 301</td>
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<tr>
<td>HU 3283</td>
<td>Level II German for Special Purposes</td>
<td>Review of the basics of the German language. Extensive work on the creative use of written and oral German with emphasis on short themes in German.</td>
<td>Fall, Spring</td>
<td>3.0</td>
<td>(0-3-0)</td>
<td>HU 3282 or Language Placement German &gt;= 451</td>
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<tr>
<td>HU 3284</td>
<td>Level III in German Literature and Culture</td>
<td>Study of German literature and cultures. Topics may include postwar German literature, Germany since WWII, or emphasis on a major contemporary writer. Readings, discussion and writing in German.</td>
<td>Fall, Spring</td>
<td>3.0</td>
<td>(0-3-0)</td>
<td>HU 3282 or Language Placement German &gt;= 301 or CEEB German Language &gt;= 3</td>
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<tr>
<td>HU 3285</td>
<td>Level III German: Film and Media</td>
<td>Focus on improving advanced language skills for professional communicative situations, including acquisition of discipline-specific vocabulary (preparation for language certification). Topics may include issues of science and technology in German-speaking countries.</td>
<td>Spring</td>
<td>3.0</td>
<td>(0-3-0)</td>
<td>HU 3282 or Language Placement German &gt;= 521 or CEEB German Language &gt;= 3</td>
<td></td>
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<tr>
<td>HU 3291</td>
<td>Level II Spanish Language and Culture</td>
<td>Review and continued study of grammar, vocabulary, speaking, listening, reading, and writing in Spanish. Includes written compositions and oral presentations. Cultural focus on several Spanish-speaking regions. Students completing this course may apply for placement credit.</td>
<td>Fall, Spring</td>
<td>3.0</td>
<td>(0-3-0)</td>
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<tr>
<td>HU 3292</td>
<td>Level II-B Spanish Language and Culture</td>
<td>Continued study of grammar, vocabulary, speaking, listening, reading, and writing in Spanish. Includes written compositions, oral presentations, and readings of short literary and documentary texts. Strong cultural focus on several Spanish-speaking regions. Students completing this course may apply for placement credit.</td>
<td>Fall, Spring</td>
<td>3.0</td>
<td>(0-3-0)</td>
<td>HU 2292 or HU 2293 or Language Placement Spanish &gt;= 321</td>
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<tr>
<td>HU 3293</td>
<td>Level IIC Spanish Composition and Conversation</td>
<td>Advanced grammar, composition, and conversation practice. Readings may include texts from literary, social, economic, scientific, engineering, or business discourses in the context of Hispanic cultures. Students completing this course may apply for placement credit.</td>
<td>Fall, Spring</td>
<td>3.0</td>
<td>(0-3-0)</td>
<td>HU 2293 or HU 2291 or HU 3292 or Language Placement Spanish &gt;= 401</td>
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<tr>
<td>HU 3294</td>
<td>Hispanic Literatures and Cultures</td>
<td>Study of selected works of literature, culture, and civilization from selected regions of the Spanish-speaking world. May incorporate study of literary genres and historical periods as related to Spain and/or Latin American cultures. Students completing this course may apply for placement credits.</td>
<td>Fall, Spring</td>
<td>3.0</td>
<td>(0-3-0)</td>
<td>HU 3293 or Language Placement Spanish &gt;= 631</td>
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<tr>
<td>HU 3295</td>
<td>Level III Advanced Spanish for Literacies</td>
<td>Spanish for Special Purposes is designed for students who anticipate careers in which they will need to interact with Hispanic communities in the U.S. or abroad and who wish to continue study of Spanish language and culture for specific professional purposes. Topics include Spanish for engineering and other sciences, healthcare, business, and legal professions.</td>
<td>Fall, Spring</td>
<td>3.0</td>
<td>(0-3-0)</td>
<td>HU 3293 or Language Placement Spanish &gt;= 631</td>
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<tr>
<td>HU 3296</td>
<td>Introduction to Hispanic Literatures and Cultures</td>
<td>Overview of Iberian and/or Latin American literatures and cultures from colonial through contemporary periods, including the arts and popular movements, from a multidisciplinary perspective. Course is repeatable up to six credits.</td>
<td>Fall - Offered alternate years beginning with the 2015-2016 academic year</td>
<td>3.0</td>
<td>(0-3-0)</td>
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<tr>
<td>HU 3325</td>
<td>Film History and Theory</td>
<td>Survey of film history and theory and their technological and sociocultural contexts. Focus on key concepts and movements such as narrative, auteurism, realism, and genre.</td>
<td>Spring</td>
<td>3.0</td>
<td>(0-2-2)</td>
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<tr>
<td>HU 3326</td>
<td>Topics in World Cinema</td>
<td>This course focuses on mainstream and/or independent films in their historical and sociocultural contexts from selected regions such as Latin America, Africa, the Middle East, Asia, and Europe.</td>
<td>Spring</td>
<td>3.0</td>
<td>(1-2-0)</td>
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</table>
HU 3400 - Topics in Diversity Studies
This course provides students with a better understanding of underrepresented populations within the United States by examining the culture and experience of African American; American Indian; Asian American; Latina/Latino American; Gay, Lesbian, Bisexual, and Transsexual; or Post-Colonial peoples. Credits: 3.0; Repeatable to a Max of 9 Lec-Rec-Lab: (0-3-0) Semesters Offered: Spring, Summer Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3401 - Gender and Culture
Interrelations of gender and culture, including comparative analysis of constructions of gender. May examine different societies and/or different historical periods. Credits: 3.0; Repeatable to a Max of 6 Lec-Rec-Lab: (0-3-0) Semesters Offered: On Demand Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3502 - Mythologies
Survey of the major mythological systems of the world with particular attention to those areas of commonality among various civilizations. Films may provide contextual background. Credits: 3.0 Lec-Rec-Lab: (0-3-0) Semesters Offered: Spring - Offered alternate years beginning with the 2001-2002 academic year Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3504 - Studies in the Novel
Examination of the novel in world literature with special attention to the historical, cultural, and personal contexts within which the author is writing. Film versions may be examined. Credits: 3.0 Lec-Rec-Lab: (0-3-0) Semesters Offered: On Demand Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3505 - Forms, Genres, and Modes
An examination of the formal elements that convey meaning and shape our interpretation of literary and/or cinematic texts. Emphasis will be on the definition, contexts and evolution of forms, genres, and modes. Credits: 3.0; Repeatable to a Max of 6 Lec-Rec-Lab: (0-3-0) Semesters Offered: Fall Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3506 - Major Authors
An intensive study of the life and works of one or more significant literary figures. This course will also focus on the social and historical contexts that shaped the author's reputation and standing in the literary, theatrical, or cinematic canon. Credits: 3.0 Lec-Rec-Lab: (0-3-0) Semesters Offered: Spring Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3507 - Critical Studies in Periods and Movements
An advanced study of a specific transnational or trans-Atlantic historical period or aesthetic movement that illustrates the development of literary and/or cinematic traditions. Courses will include relevant theory and criticism. Credits: 3.0; Repeatable to a Max of 6 Lec-Rec-Lab: (0-3-0) Semesters Offered: Fall Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3513 - Shakespeare
In-depth study of a limited number of Shakespearean plays with special attention to dramatic structure, character development, theme presentation, and theatre history. Includes extensive study of Renaissance influences, possibly film versions of selected plays, and examination of current critical theories. Credits: 3.0 Lec-Rec-Lab: (0-3-0) Semesters Offered: Fall, Spring Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3514 - Workshop in Creative Nonfiction
Advanced work in creative nonfiction writing; workshop format. Readings will include short memoirs, personal essays, lyric essays, and other sub-genres of contemporary creative nonfiction. Emphasis on individual production through process-oriented writing exercises, small group workshops, individual conferences, and revision/development. Credits: 3.0 Lec-Rec-Lab: (0-3-0) Semesters Offered: Spring Pre-Requisite(s): HU 2510 and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3515 - Workshop in Poetry
Advanced work in poetry writing; workshop format. Students will study contemporary and emerging works in order to enrich and stimulate their own poetic practice. Emphasis on individual production through process-oriented writing exercises, small group workshops, individual conferences, and revision/development. Credits: 3.0 Lec-Rec-Lab: (0-3-0) Semesters Offered: Fall Pre-Requisite(s): HU 2510 and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3516 - Workshop in Fiction
Advanced work in fiction writing; workshop format. Readings will include "canonical", contemporary, and emerging examples of short-form fiction. Emphasis on individual production through process-oriented writing exercises, small group workshops, individual conferences, and revision/development. Credits: 3.0 Lec-Rec-Lab: (0-3-0) Semesters Offered: Spring - Offered alternate years beginning with the 2004-2005 academic year Pre-Requisite(s): UN 1015

HU 3540 - Major British Authors
In-depth reading of the works of one or more British authors (excluding Shakespeare), including surrounding criticism. Film versions may be examined. Credits: 3.0; Repeatable to a Max of 6 Lec-Rec-Lab: (0-3-0) Semesters Offered: Spring - Offered alternate years beginning with the 2015-2016 academic year Pre-Requisite(s): UN 1015

HU 3541 - Major American Authors
In-depth reading of the works of one or more American authors, including surrounding criticism. Film versions may be examined. Credits: 3.0; Repeatable to a Max of 6 Lec-Rec-Lab: (0-3-0) Semesters Offered: Spring - Offered alternate years beginning with the 2016-2017 academic year Pre-Requisite(s): UN 1015

HU 3545 - Literature Across Borders
Study of literary genres, themes, and movements, with emphasis on comparing and contrasting perspectives reflected in literatures from Western and non-Western cultures. Topics may focus on historical, social, aesthetic, and cultural factors as they influence these literatures. Films may be used. Credits: 3.0 Lec-Rec-Lab: (0-3-0) Semesters Offered: Fall - Offered alternate years beginning with the 2004-2005 academic year Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3554 - Science Fiction and Fantasy Literature
Close study of significant works in science fiction and fantasy. Examines genre features and usage and attends to a writer's style and methods. Regularly focuses on historical fiction and fantasy using film to help establish literary context. Credits: 3.0; Repeatable to a Max of 6 Lec-Rec-Lab: (0-3-0) Semesters Offered: On Demand Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)
HU 3557 - Literature and Science
Focuses on depictions of science in literature and literary features of scientific texts from a range of historical periods, genres, and nationalities. May include the influence of scientific methods on literature and vice versa (for instance, narrative medicine).
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2015-2016 academic year
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3600 - Professional Development in the Humanities
Addresses conventions and expectations for professional development through projects such as portfolio development and research into contemporary professional and work place issues. Explores career and graduate school opportunities.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Major(s): Comm and Culture Studies, Scientific & Tech Comm (BS), Liberal Arts, Scientific & Tech Comm (BA), Humanities, English; May not be enrolled in one of the following Class(es): Freshman

HU 3605 - Grammar and Usage in Society
Description and analysis of current standards of grammar and usage in the U.S. Students acquire an understanding of the structures of American English as well as an understanding of the social forces underlying standardization and the processes of language change.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

HU 3606 - Editing
Examination of the responsibilities of an editor and grounding in basic editorial skills. Topics include situations of editing, levels of editing, readability, correctness, style, relations with authors, and social and political implications of editing.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

HU 3621 - Introduction to Journalism
Introduction to the history and practice of journalism. Includes critical analysis of journalistic coverage, journalistic style and editing, and ethical issues in journalism.
Credits: 3.0
Lec-Rec-Lab: (0-2-3)
Semesters Offered: Fall
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3630 - Publications and Information Management
Principles of information selection, editing, layout, and graphics essential to the scheduling, budgeting, and production of various print and digital publications.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): HU 2642 and HU 2633 or HU 2645

HU 3650 - Introduction to Web Design
Provides experience in planning and constructing web pages. Discusses historical, ethical, and social implications, as well as problems and limitations, of the Internet and the World Wide Web. Students develop a balance of technical, aesthetic, and theoretical knowledge.
Credits: 3.0
Lec-Rec-Lab: (0-2-3)
Semesters Offered: Fall
Pre-Requisite(s): HU 2642 and HU 2645 or HU 2633

HU 3700 - Philosophy of Science
Examination of problems involved in scientific methodology such as theory structure, concept formation, scientific explanation, hypothetico-deductive model, role of experimentation, function of paradigms and analogies, distinction between science and pseudoscience, extent to which science is value-free or value-laden, social responsibility of scientists, and aims of science.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3701 - Philosophy of Technology
A study of philosophical analyses of technology. Topics may include: the essence and nature of technology, technology and human existence; the notion that we live in a technological age; and ethical issues surrounding the use, abuse, and ubiquity of technology.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3702 - Philosophy of Religion
An examination of some philosophical questions in diverse religious traditions including the existence of God, the problem of evil, and the nature of religious experience.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3710 - Engineering Ethics
A study of ethical questions confronting individual engineers and the engineering profession. Among the issues to be explored are the meaning of professionalism, the social responsibilities of engineers, engineer-employer and engineer-client relationships, whistle-blowing, conflicts of interest, and competitive bidding.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3711 - Biomedical Ethics
A study of several important ethical and philosophical issues that arise in medical practice and in biomedical science. Issues may include euthanasia, abortion, the physician-patient relationship, experimentation involving human subjects, and allocation of scarce biomedical resources. General ethical theories and concepts are used to shed light on those issues.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3800 - Communication Theory
Examines key communication theories from the twentieth century to the present. Emphasis on understanding the value of theory in relation to contemporary issues.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3810 - Technology and Cultural Theory
Considers interrelationships between technology and culture. Includes understanding the context within which technologies are developed and used, and how assumptions about technology shape knowledge, practice, and creative action. Issues such as progress, determinism, ethics, gender, race, class, globalization, and "humanness".
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3820 - Interpersonal Communication
Examines practices and issues of relational communication and encourages critical awareness of common assumptions. Topics include verbal and nonverbal cues, conflict models, friendship, intimacy, and the interpersonal significance of race, gender, class, and disability.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3830 - Creativity, Culture, and Change
Examines the sources of creativity and the ways that it has been used to change cultural values, feelings, beliefs, and practices. A project-based course that cultivates and applies creative action toward cultural change.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)
HU 3832 - Advanced Digital Presentation
Students will use digital delivery modes to design and deliver presentations for a variety of social and professional purposes. Students will explore the ethical, social, and political implications of digital delivery for civic life and public discourse.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3840 - Organizational Communication
An approach to understanding organizations in their socio-historical contexts from a variety of theoretical perspectives in communication. Explores meanings, roles, relations, interactions, and structures from a communication perspective.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3850 - Cultural Studies
Examines the way that culture communicates values, feelings, beliefs; structures differential relations of power and possibility; creates difference and hierarchy. Considers the struggles over meaning that open up possibilities for diversity and change.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2015-2016 academic year
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3860 - Popular Culture
Introduces fundamentals of cultural theory and media criticism. Considers historical, social, political, and economic contexts of popular culture from a media studies perspective.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3871 - New Media Theory
Examines relationships among changing communication technologies and communication theories. Emphasizes issues involving emerging technologies and emerging theory.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3882 - Media Industries
Examines economic, political, and cultural aspects of media industries (cinema, broadcasting, music, gaming, telecommunications, and advertising) from historical and contemporary contexts.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall

HU 3890 - Documentary
Considers technical, theoretical, aesthetic and ethical dimensions of documentary media through analysis and production.
Credits: 3.0
Lec-Rec-Lab: (0-2-3)
Semesters Offered: Fall

HU 3910 - Global Language Issues
Considers the historical rise of the English language and other dominant languages, and present effects on minority and endangered languages within the US and abroad; World Englishes and dialectal variation; and the interaction of forces of globalization/standardization with localization/identity.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2009-2010 academic year
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3940 - Language and Identity
Examines how individuals create and perform their social identities through and in response to language, considering social variables such as race, ethnicity, class, gender, sexuality, disability, geography, power, ideology, etc. Explores how these variables may intersect, clash, and be resolved.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2010-2011 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3961 - Theoretical Foundation of TESOL
Introduction to key concepts and issues in teaching English to speakers of other languages. Topics covered may include nature of first-and-second acquisition, role of input and instruction in language learning, and evaluation of approaches to teaching and research.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Co-Requisite(s): HU 3605
Pre-Requisite(s): HU 2910

HU 3962 - TESOL Methods and Materials
Enhance understanding and awareness of the developmental stages and needs of English language learners in various learning contexts. Show how to adjust, modify, and manipulate instructional techniques and materials to accommodate the linguistic and cognitive needs of English learners.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): HU 3961

HU 3963 - Assessment and Testing in TESOL
This course covers basic principles and approaches in the assessment and testing of English as a second or foreign language in various instructional contexts. Topics covered may include test construction and adaptation and the application of this knowledge to evaluating tests.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): HU 3961

HU 3964 - Cross-Cultural Aspects of TESOL
Course examines those places where language and culture come together to affect our interactions; concentrating on areas particularly important to language teaching, learning, and usage. Topics may include introduction to pragmatics, politeness theory, and conversational politeness strategies.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Freshman

HU 4050 - Special Topics
Tutorial, seminar, workshop, or class study of special interest and importance in the humanities. Students should register by section number for the appropriate instructor and topic.
Credits: variable to 6.0; May be repeated
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required

HU 4060 - Humanities Workshop
Special workshop projects in the humanities such as tutorials, editing, Shakespeare Faire drama workshop, writer’s workshop, or study-abroad tours. Approved credit varies by degree program.
Credits: variable to 6.0; May be repeated
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required

HU 4101 - Mult literacies Center Practicum
Reflective practicum in which theories of learning, literacy, and cultural differences are applied in the Multiliteracies Center setting under the supervision of a writing center professional.
Credits: 1.0; May be repeated
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall, Spring
Restrictions: Permission of instructor required
Pre-Requisite(s): UN 1015

HU 4130 - Special Topics in Rhetoric and Composition
An in-depth examination of particular issues, theories, methodologies, or concepts in the field of rhetoric and composition, such as comparative rhetorics, computers and writing, multi-lingual writing, feminist rhetorics, and multi-modal composition.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2000-2001 academic year

HU 4140 - Methods of Teaching English
Application of learning theories and national and state professional standards to the teaching of English. Emphasizes methods, materials, and media used to teach adolescents. Requires admission to teacher education program or permission of instructor. Includes significant time in the field.
Credits: 4.0
Lec-Rec-Lab: (0-3-3)
Semesters Offered: Fall
Restrictions: Permission of department required
Pre-Requisite(s): ED 3110 and ED 3210 and ED 3410 and ED 4700(C)

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HU 4150 - Literacy in the Content Areas
Introduction to the best ways to use language for deepening comprehension and understanding in all content areas. Inquiries into how cultural and learning differences relate to comprehension. A minimum of 28 tutoring hours in a local school is required.

Credits: 4.0
Lec-Rec-Lab: (0-3-1)
Semesters Offered: Fall, Spring
Pre-Requisite(s): ED 3110 and ED 3210 and ED 3410

HU 4271 - Modern Language Seminar I-French
Language and power. Critical study of the representation of politics, economics, and social institutions in literature, film, and authentic documents from French, German, and Hispanic language communities. Students read texts in French and English translation. Course offered third year beginning 2009-2010.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Pre-Requisite(s): HU 3274 or HU 3275

HU 4272 - Modern Language Seminar II-French
Individual and society. Critical study of the relationship between the individual and social institutions in literature, film, and authentic documents from French, German, and Hispanic language communities. Students read texts in French and in English translation. Course offered third year beginning 2010-2011.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring - Offered alternate years beginning with the 2001-2002 academic year
Pre-Requisite(s): HU 3274 or HU 3275

HU 4273 - Modern Language Seminar III-French

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Pre-Requisite(s): HU 3274 or HU 3275

HU 4281 - Modern Language Seminar I-German
Language and power. Critical study of the representation of politics, economics, and social institutions in literature, film, and authentic documents from French, German, and Hispanic language communities. Students read texts in German and in English translation. Course offered every third year beginning 2009-2009.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): HU 3284 or HU 3285

HU 4282 - Modern Language Seminar II-German
Individual and society. Critical study of the relationship between the individual and social institutions in literature, film, and authentic documents from French, German, and Hispanic language communities. Students read texts in German and in English translation. Course offered every third year beginning 2009-2010.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring - Offered alternate years beginning with the 2001-2002 academic year
Pre-Requisite(s): HU 3284 or HU 3285

HU 4283 - Modern Language Seminar III-German
Technology in literature and film. Critical study of the representation of modern technology in literature, film, and authentic documents from French, German, and Hispanic language communities. Students read texts in German and in English translation. Course offered every third year beginning 2010-2011.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2015-2016 academic year
Pre-Requisite(s): UN 1015 and UN 1025 or Modern Language - 3000 level or higher

HU 4500 - Advanced Seminar
A course especially designed for English majors. In depth exploration of various topics with special emphasis on theory and production. Students will be required to engage relevant secondary sources and theory in a longer, final seminar paper.

Credits: 3.0; Repeatable to a Max of 6
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

HU 4501 - BA Thesis
Students will be required to engage relevant secondary sources and theory in a longer, final seminar paper or creative project. Produce a cultural final project that demonstrates advanced critical and creative analysis. Proposals must be approved in the prior semester.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior

HU 4510 - Color, Visuality, and Culture
Engages with color as an aesthetic, theoretical, historical, cultural, and political concept. Explores what color is made of, how color shapes meaning, and how color functions in various expressive and interpretative contexts including politics, science, and industry.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2015-2016 academic year
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 4600 - Humanities Internship
Provides internship experience directly related to student’s course of study. Students conduct work at internship site in addition to academic assignments that encourage them to connect their professional and academic experience. Requires approval of department internship coordinator.

Credits: variable to 6.0; May be repeated
Semesters Offered: On Demand
Restrictions: Permission of department required

HU 4625 - Risk Communication
Examines models for communicating risks associated with environmental, safety, and health hazards. Considers the diverse roles assumed by the public under each of these models and means of ensuring that risks are communicated fairly, honestly, and accurately.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 4626 - International Technical Communication
Focuses on international workplace communication. Introduces theories of globalization. Topics may include localization, contrastive rhetoric, technical translation, and international usability.

Credits: 3.0
Lec-Rec-Lab: (2-1-0)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): HU 2600
HU 4628 - Usability and Instructions Writing
The role of readability and usability in technical communication. Topics include social, cultural, and cognitive theories of reading processes, navigation, print and online document design. Applies readability and usability testing techniques to typical print materials as well as online documents, digital libraries or databases, multimedia, or software interfaces.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): HU 3120 and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 4634 - Advanced Practicum in Scientific and Technical Communication
Provides technical communication majors with opportunities to design and produce various communication products expected in their working careers, such as sets of procedures, proposals, progress reports, sets of directions, and style sheets. The course will also require students to complete, with advice from the instructor, one major client-involved project such as a brochure, newsletter, web site, technical training module, etc.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Major(s): Scientific & Tech Comm (BS), Scientific & Tech Comm (BA)
Pre-Requisite(s): HU 3120 and HU 2600

HU 4642 - Advanced Topics in Media
Critical and applied topics in advanced media, theory and development. Topics may include game design, mobile media, color, photography, film, or graphic design.
Credits: 3.0; Repeatable to a Max of 6
Lec-Rec-Lab: (0-2-3)
Semesters Offered: On Demand
Restrictions: Permission of instructor required

HU 4690 - Special Topics in Technical and Professional Communication
In-depth examination of selected topics in scientific and technical communication, or on professional and workplace writing in selected genres such as reports, proposals, or whitepapers.
Credits: 3.0; Repeatable to a Max of 9
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Freshman

HU 4693 - Science Writing
Introduces writing, research, and editing that contribute to a public understanding of science. Possible topics: health, environment, medicine, public policy. All majors welcome.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 4694 - Grant Writing
Introduces fundamentals of grant proposal writing/research. Possible topics: writing for nonprofits, grant writing in various disciplines, researching funding sources. All majors welcome.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 4695 - Digital Rhetorics
Social, ethical, and historical implications of digital rhetorics, investigating the rhetorical affordances of digital contexts with special attention to digital content and interface design.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): HU 2642 or HU 2130 or HU 3120

HU 4700 - Topics in Philosophy
The topics will ordinarily be in-depth examinations of a particular philosopher or philosophical problem, tradition, or historical period. Examples include the philosophy of Kant, the existence of God, American pragmatism, death and dying, and ancient Greek philosophy.
Credits: 3.0; Repeatable to a Max of 9
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Pre-Requisite(s): UN 1015

HU 4701 - Political Philosophy
Issues in political philosophy, such as the moral foundations of political systems, the proper relation between the individual and the state, and the justification of social institutions. Philosophers studied may include Plato, Aristotle, Machiavelli, Hobbes, Locke, Marx, de Tocqueville, Mill, Dewey, and Rawls.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 4725 - Existentialism and Phenomenology
Introduction to the philosophical traditions of existentialism and phenomenology. Topics might include: the nature of human existence and of freedom; the importance of work, self, anxiety, death, and authenticity; and the foundations of knowledge, experience and meaning.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2013-2014 academic year

HU 4800 - Media and Globalization
Examines the development of modern international communication systems, the rise of transnational media industries and technologies, and debates about their global impacts.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2014-2015 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 4890 - Topics in Communication
In-depth examination of selected issues or problems in the study of communication, such as gender and communication, the environment and communication, sound and communication, violence and communication.
Credits: 3.0; Repeatable to a Max of 9
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 4961 - Practicum in TESOL
Observation, case studies, tutoring, instructional assistance, and supervised teaching experience in English to speakers of other languages.
Credits: variable to 6.0; Repeatable to a Max of 6
Semesters Offered: Fall, Spring, Summer
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): HU 3962

Mathematical Sciences

MA 0010 - Development of Mathematics Skills
Individualized instruction in mathematics problem solving and general study skills from professional math coaches. Helps students with demanding college-level mathematics courses. Credits do not count toward graduation.
Credits: 0.0; May be repeated
Semesters Offered: Fall, Spring
Restrictions: Permission of instructor required

MA 0030 - Team Approach for College Algebra
Collaborative approach to the study of mathematics. Helps students with MA1030 and gives experience in team problem solving. Credit does not count toward graduation.
Credits: 0.0; May be repeated
Semesters Offered: Fall, Spring
Co-Requisite(s): MA 1030

MA 0031 - Team Approach for College Algebra II
Collaborative approach to the study of mathematics. Helps students with MA1031 and gives experience in team problem solving. Credit does not count toward graduation.
Credits: 0.0; May be repeated
Semesters Offered: Fall, Spring, Summer
Co-Requisite(s): MA 1031
MA 1020 - Quantitative Literacy
Stresses the role of contemporary mathematical thinking and the connection between mathematics and our daily lives. Topics include the mathematics of the Census, planning and scheduling, coding theory, game theory, symmetry and patterns, logic and modeling, and political flavor topics.
Credits: 4.0
Lec-Rec-Lab: (0-4-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Major(s): Comm and Culture Studies, Theatre & Electr. Media Perf., Theatre & Entertain Tech (BS), Theatre & Entertain Tech (BA), Scientific & Tech Comm (BS), Psychology, Sports and Fitness Management, History, Social Sciences, Liberal Arts with History Opt, Scientific & Tech Comm (BA), Humanities, Liberal Arts
Pre-Requisite(s): ALEKS Math Placement >= 00

MA 1030 - College Algebra I
Review of algebra covering roots, radicals, factoring polynomial and rational expressions, equations, and inequalities, functions, and graphs.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Co-Requisite(s): MA 0030
Pre-Requisite(s): ALEKS Math Placement >= 00

MA 1031 - College Algebra II with Trigonometry
A continued study of algebra and trigonometry covering functions and graphs, trigonometric graphs, identities and equations, and inverse trigonometric functions. MA1030 and MA1031 together are equivalent to MA1032.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring, Summer
Co-Requisite(s): MA 1030
Pre-Requisite(s): MA 1030

MA 1032 - Precalculus
Review of algebra and trigonometry covering roots, radicals, factoring polynomial and rational expressions, equations and inequalities, functions and graphs, trigonometric graphs, identities and equations and inverse trigonometric functions.
Credits: 4.0
Lec-Rec-Lab: (0-4-0)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): ALEKS Math Placement >= 56

MA 1035 - Calculus for Life Sciences
Topics include analytic geometry, limits, continuity of functions, transcendental functions, derivatives, integrals, and applications of the derivative in the fields of economics, biological sciences, and social sciences. Extensive use of graphing calculator. (See mathematical sciences department for recommended calculator). Credit applicable only to those curricula specifying this course.
Credits: 4.0
Lec-Rec-Lab: (0-4-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: May not be enrolled in one of the following College(s): College of Engineering
Pre-Requisite(s): MA 1032 or MA 1031 or ALEKS Math Placement >= 70 or CEEB Calculus AB >= 2 or CEEB Calculus BC >= 2 or CEEB Calculus AB Subscore >= 2

MA 1160 - Calculus with Technology I
An introduction to single-variable calculus, which includes a computer laboratory. Topics include trigonometric, exponential, and logarithmic functions, differentiation and its uses, and basic integration. Integrates symbolic tools, graphical concepts, data and numerical calculations.
Credits: 4.0
Lec-Rec-Lab: (0-3-1)
Semesters Offered: Fall, Spring
Pre-Requisite(s): MA 1032 or MA 1031 or ALEKS Math Placement >= 80 or CEEB Calculus AB >= 3 or CEEB Calculus BC >= 3 or CEEB Calculus AB Subscore >= 3

MA 1161 - Calculus Plus w/ Technology I
An introduction to single-variable calculus, which includes a computer laboratory. Topics include trigonometric, exponential, logarithmic functions, differentiation and its uses, and basic integration. Integrates symbolic tools, data and numerics, and graphical concepts and is similar to MA1161, going at a different pace.
Credits: 5.0
Lec-Rec-Lab: (0-4-1)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): MA 1032 or MA 1031 or ALEKS Math Placement >= 70 or CEEB Calculus AB >= 2 or CEEB Calculus BC >= 2 or CEEB Calculus AB Subscore >= 2

MA 1600 - Introduction to Scientific Simulation
Introduction to simulation, a powerful computational tool for many scientific problems. Case studies and projects will be drawn from various fields. Prior programming experience is not required; all necessary computational skills will be developed in the course.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Spring
Pre-Requisite(s): MA 1160 or MA 1161

MA 1910 - Exploring Symmetry Groups
Mathematical discovery and invention in group theory: transformations, finite figures, strip patterns, wall patterns, finite groups, and Cayley diagrams.
Develops the ability to find and describe patterns, to generalize from observations, to formulate conjectures, and to support conjectures with analysis and, when possible, formal proof.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2000-2001 academic year

MA 1920 - Exploring Knots and Surfaces
Mathematical discovery and invention in topological graph theory: networks, graphs, graph coloring, surfaces and graphs, and knots. Develops the ability to find and describe patterns, to generalize from observations, to formulate conjectures, and to support conjectures with analysis and, when possible, formal proof.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2001-2002 academic year

MA 1930 - Exploring Number Theory
Mathematical discovery and invention in number theory: number puzzles, Chinese Remainder Theorem, codes, primitive roots, and quadratic reciprocity.
Develops the ability to find and describe patterns, to generalize from observations, to formulate conjectures, and to support conjectures with analysis and, when possible, formal proof.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2006-2007 academic year

MA 1940 - Exploring Non-Euclidean Geometry
Mathematical discovery and invention in Non-Euclidean geometry: definitions of straight and angle, transformations, congruence, parallel transport, projections, and finite geometries. Develops the ability to find and describe patterns, to generalize from observations, to formulate conjectures, and to support conjectures with analysis and, when possible, formal proof.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2003-2004 academic year

MA 1990 - Elementary Mathematics Topics
Students study a particular area in mathematics, ordinarily not covered in existing courses. Intended for first-year students.
Credits: variable to 6.0; Repeatable to a Max of 6
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required

MA 2020 - Prep for Putnam Exam
Half-semester course emphasizing problem solving skills in areas typically covered by the Putnam Exam. These include, but are not limited to, modular arithmetic, combinatorics, probability, (linear) algebra and analysis.
Credits: 1.0; Repeatable to a Max of 4; Graded Pass/Fail Only
Lec-Rec-Lab: (0-2-0)
Semesters Offered: Fall

MA 2160 - Calculus with Technology II
Continued study of calculus, which includes a computer laboratory. Topics include integration and its uses, function approximation, vectors, and elementary modeling with differential equations.
Credits: 4.0
Lec-Rec-Lab: (0-3-1)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): MA 1160 or MA 1161 or MA 1135 or CEEB Calculus AB >= 3 or CEEB Calculus BC >= 3 or CEEB Calculus AB Subscore >= 3

MA 2320 - Elementary Linear Algebra
An introduction to linear algebra and how it can be used. Topics include systems of equations, vectors, matrices, orthogonality, subspaces, and the eigenvalue problem. Not open to students with credit in MA2321 or MA2330.
Credits: 2.0
Lec-Rec-Lab: (0-2-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: May not be enrolled in one of the following Major(s): Mathematics, Software Engineering, Computer Science
Pre-Requisite(s): MA 1160 or MA 1161 or MA 1135

MA 2321 - Elementary Linear Algebra
Offered first half of semester, to be taken concurrently with MA3521. The course is an introduction to linear algebra and how it can be used. Topics include systems of equations, vectors, matrices, orthogonality, subspaces and the eigenvalue problem. Not open to students with credit in MA2320 or MA2330.
Credits: 2.0
Lec-Rec-Lab: (0-4-0)
Semesters Offered: Fall, Spring
Restrictions: May not be enrolled in one of the following Major(s): Mathematics, Software Engineering, Computer Science
Pre-Requisite(s): MA 3521

Pre-Requisite(s): MA 2160
MA 2330 - Introduction to Linear Algebra
An introduction to linear algebra and how it can be used, including basic mathematical proofs. Topics include systems of equations, vectors, matrices, orthogonality, subspaces, and the eigenvalue problem. Not open to students with credit in MA2320 or MA2321.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): MA 1160 or MA 1161 or MA 1135

MA 2600 - Scientific Computing
Use of mathematical modeling and computer simulation to solve scientific problems. Includes introduction to elementary numerical methods (numerical integration, solution of linear systems, solution of nonlinear equations, optimization) and to computer programming. Requires programming project(s).
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Fall
Pre-Requisite(s): MA 2160 and (MA 2320 or MA 2321 or MA 2330)

MA 2710 - Introduction to Statistical Analysis
Introduction to statistical reasoning and methods. Topics include uses and abuses of statistics, graphical and descriptive methods, correlation and regression, probability and statistical inference. The course will include a written project and an introduction to statistical software. Not open to students with credit in MA2710 or MA3710 or MA3715.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Major(s): Statistics, Mathematics
Pre-Requisite(s): MA 1160 or MA 1161 or MA 1135

MA 2720 - Statistical Methods
Introduction to the design and analysis of statistical studies. Topics include methods of data collection, descriptive and graphical methods, probability, statistical inference on means, regression and correlation, and single variable ANOVA. Not open to students with credit in MA2710, MA3710, or MA3715.
Credits: 4.0
Lec-Rec-Lab: (0-4-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: May not be enrolled in one of the following Major(s): Mathematics
Pre-Requisite(s): MA 1020 or MA 1030 or ALEKS Math Placement >= 40

MA 2910 - Mathematical Experimentation
Mathematical discovery and invention in topics such as algebra, analysis, applied mathematics, discrete mathematics, geometry, and statistics. Class projects require students to find and describe patterns, generalize from observations, formulate and support conjectures with analysis and, when possible, proof. Projects require written reports describing the student's findings, conjectures, and conclusions.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Spring
Pre-Requisite(s): MA 1160 or MA 1161

MA 2990 - Elementary Topics in Mathematics
Students study a particular area in mathematics ordinarily not covered in other courses. Intended for first- or second-year students.
Credits: variable to 4.0; Repeatable to a Max of 6
Restrictions: Permission of instructor required
Pre-Requisite(s): MA 2160

MA 3160 - Multivariable Calculus with Technology
Introduction to calculus in two and three dimensions, which includes a computer laboratory. Topics include functions of several variables, partial derivatives, the gradient, multiple integrals; introduction to vector-valued functions and vector calculus, divergence, curl, and the integration theorems of Green, Stokes, and Gauss.
Credits: 4.0
Lec-Rec-Lab: (0-3-1)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): MA 2160

MA 3202 - Introduction to Coding Theory
Transmission via noisy channels, hamming distance, linear codes, the ISBN-code, encoding and decoding, finite fields, Reed-Solomon codes, deep space communication, the compact disk code, sphere packing bound, hamming codes, hamming decoding.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): MA 2320 or MA 2321 or MA 2330

MA 3203 - Introduction to Cryptography
Topics include private-key cryptography, shift substitution, permutation and stream ciphers, cryptanalysis, perfect secrecy, public-key cryptography, and the RSA cryptosystem.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring, Summer
Pre-Requisite(s): MA 2320 or MA 2321 or MA 2330

MA 3210 - Introduction to Combinatorics
Topics include set theory, mathematical induction, integers, functions and relations, counting methods, recurrence relations, generating functions, permutations, combinations, principle of inclusion and exclusion, graphs (including planar graphs). Further possible topics are graph coloring, trees and cut-sets, combinatorial designs, Boolean algebra.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Summer
Pre-Requisite(s): MA 2320 or MA 2321 or MA 2330

MA 3310 - Introduction to Abstract Algebra
Introduction to proofs in algebra. Topics include elementary number theory (induction, binomial theorem, fundamental theorem of arithmetic, Euclidean algorithm, congruences, Fermat's theorem), group theory (subgroups, cyclic groups, generators, Lagrange's theorem, normal groups, homomorphisms, quotients), ring theory (domains, fields, polynomials, homomorphisms).
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Summer
Pre-Requisite(s): MA 2320 or MA 2321 or MA 2330

MA 3450 - Introduction to Real Analysis
Why calculus works: a careful study of the logical basis of calculus, with an emphasis on how to read and write proofs. Topics include set theory, real numbers, infinite sequences, continuity, derivatives and integrals for functions of one variable, sequences of functions, infinite series.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): MA 2160

MA 3520 - Elementary Differential Equations
First order equations, linear equations, and systems of equations. Not open to students with credit in MA3521, MA3530 or MA3560.
Credits: 2.0
Lec-Rec-Lab: (0-2-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: May not be enrolled in one of the following Major(s): Mathematics
Pre-Requisite(s): MA 2160 and (MA 2320 or MA 2321 or MA 2330)

MA 3521 - Elementary Differential Equations
Offered second half of semester, to be taken concurrently with MA2321. Topics include first order equations, linear equations and systems of equations. Not open to students with credit in MA3520, MA3530 or MA3560.
Credits: 2.0
Lec-Rec-Lab: (0-4-0)
Semesters Offered: Fall, Spring
Restrictions: May not be enrolled in one of the following Major(s): Mathematics
Pre-Requisite(s): MA 2160

MA 3525 - Introduction to Differential Equations
First order equations, linear equations, systems of equations, and Laplace transforms. May include elementary separation of variables for partial differential equations. Not open to students with credit in MA3520, MA3521, or MA3560.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): MA 2160 and (MA 2320 or MA 2321 or MA 2330)

MA 3560 - Mathematical Modeling with Differential Equations
Creating differential equation models for physical problems such as population dynamics, kinetics, mass-spring systems. Topics include nondimensionalization, numerical methods, phase-plane analysis, first-order systems, linearization, and stability. Includes modeling case studies, using a computer algebra system, and a modeling project. Not open to students with credit in MA3520, MA3521, or MA3530.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): MA 2160

MA 3710 - Engineering Statistics
Introduction to the design, conduct, and analysis of statistical studies aimed at solving engineering problems. Topics include methods of data collection, descriptive and graphical methods, probability and probability models, statistical inference, control charts, design of experiments. Not open to students with credit in MA2710, MA2720, or MA3715.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): MA 2160

MA 3720 - Probability and Statistics
An introduction to probability and statistics for science, engineering, and business. Topics include probability, random variables, discrete and continuous probability models, expectation and variance, large sample theory, confidence intervals, hypothesis testing, regression, correlation, and an introduction to computer simulation. A project is required.
Credits: 4.0
Lec-Rec-Lab: (0-4-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): MA 3710

Restrictions: May not be enrolled in one of the following Major(s): Mathematics

MA 3725 - Probability and Statistics
An introduction to probability and statistics for science, engineering, and business. Topics include probability, random variables, discrete and continuous probability models, expectation and variance, large sample theory, confidence intervals, hypothesis testing, regression, correlation, and an introduction to computer simulation. A project is required.
Credits: 4.0
Lec-Rec-Lab: (0-4-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): MA 3710

Restrictions: May not be enrolled in one of the following Major(s): Mathematics
MA 3715 - Biostatistics
Introduction to the design and analysis of statistical studies in the health and life sciences. Topics include study design, descriptive and graphical methods, probability, inference on means, categorical data analysis, and linear regression. Not open to students with credit in MA2710, MA2720, or MA3710.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): MA 1135 or MA 1160 or MA 1161

MA 3720 - Probability
Introduction to probabilistic methods. Topics include probability laws, counting rules, discrete and continuous random variables, expectation, joint distributions, and limit theorems.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Summer
Pre-Requisite(s): MA 3160

MA 3740 - Statistical Programming and Analysis
Project-based course enabling students to identify statistical methods and analysis using R and S. Topics include exploratory data analysis, classical statistical tests, sample size and power considerations, correlation, regression, and design experiments using advanced programming techniques.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Fall
Pre-Requisite(s): MA 2710 or MA 2720 or MA 3710 or MA 3715

MA 3750 - Introduction to SAS Programming
This course is a workshop focused on solving problems for SAS certified base/certified programmers for SAS credentials.
Credits: 1.0; Graded Pass/Fail Only
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Spring
Pre-Requisite(s): MA 2710 or MA 2720 or MA 3710 or MA 3715

MA 3810 - Introduction to Actuarial Mathematics
Nominal and effective rates of interest, present value, discount, annuities certain, sinking funds, bonds, yield rates, and amortization schedules. Financial calculator skills for professional exams. Introduction to derivative securities and arbitrage pricing. May include other topics on the FM exam.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Summer
Pre-Requisite(s): MA 3160(C)

MA 3811 - Actuarial Exam Workshop
Topics from the Society of Actuaries professional examinations, primarily financial mathematics and probability. Review, preparation, and practice using SOA exams and other materials.
Credits: 1.0; Repeatable to a Max of 4; Graded Pass/Fail Only
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): MA 2710 or MA 2720 or MA 3710 or MA 3715

MA 3824 - College Geometry with Technology
Review of Euclidean geometry. Introduction to geometric constructions, conjecturing of theorems, methods of proof, 3-D geometry, finite geometries, and non-Euclidean geometries. Integrates computer software (e.g. Geometer's Sketchpad) throughout the course.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): MA 2160 or MA 2330

MA 3900 - Math Sciences Teach Experience
Development of teaching skills through assisting in the instruction of a section of an entry-level undergraduate mathematics course. Students gain experience in leadership, group work, organization skills, cooperative exercise preparation, and class instruction.
Credits: variable to 4.0; Repeatable to a Max of 4; Graded Pass/Fail Only
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required
Pre-Requisite(s): MA 2160 or MA 2330

MA 3999 - Intermediate Topics in Mathematics
Students study a particular area in mathematics, not ordinarily covered in existing courses. Intended for third-year students.
Credits: variable to 4.0; Repeatable to a Max of 6
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required

MA 4028 - Optimization and Graph Algorithms
An introduction to linear and integer programming and related graph problems. Topics include simplex algorithm, duality, branch-and-bound and branch-and-cut, shortest paths, spanning trees, matchings, network flow, graph coloring, and perfect graphs.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): MA 3210

MA 4029 - Combinatorics and Graph Theory
An introductory course in combinatorics and graph theory. Topics include designs, enumeration, extremal set theory, finite geometry, graph coloring, inclusion-exclusion, network algorithms, permutations, and trees.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): MA 3210

MA 4310 - Abstract Algebra
Detailed study of abstract algebra: elementary number theory (congruences, quadratic residues, arithmetic functions), group theory (monoids, permutation groups, homomorphisms, quotients, Lagrange's theorem, finite abelian groups, Sylow's theorems), ring theory (domains, prime and maximal ideals, quotients, PID's), splitting fields, finite fields.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): MA 3310

MA 4330 - Linear Algebra
A study of fundamental ideas in linear algebra and its applications. Includes review of basic operations, block computations; eigensystems of normal matrices; canonical forms and factorizations; singular value decompositions, pseudo inverses, least-square applications; matrix exponentials and linear systems of ODEs; quadratic forms, extremal properties, and bilinear forms.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): MA 2320 or MA 2321 or MA 2330 and MA 3160

MA 4410 - Complex Variables
A study of complex numbers, functions of a complex variable, analytic functions, elementary functions, integrals, Taylor and Laurent series, residues and poles, and conformal mapping.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): MA 3160

MA 4450 - Real Analysis
Real analysis on Euclidean n-space. Topics include real and vector valued functions, metric and normed linear spaces; an introduction to Lebesgue measure and convergence theorems.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): MA 3230 or MA 3231 or MA 2330 or MA 3450

MA 4515 - Introduction to Partial Differential Equations
An introduction to solution techniques for linear partial differential equations. Topics include: separation of variables, eigenvalue and boundary value problems, spectral methods, fourier series, and Green's functions. Studies applications in heat and mass transfer (diffusion eqn.), and mechanical vibrations (wave and beam eqns.).
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): (MA 3520 or MA 3521 or MA 3530 or MA 3560) and MA 3160

MA 4525 - Applied Vector and Tensor Mathematics
Introduction to vector and tensor mathematics with applications. Topics include vectors; vector differential calculus, space curves; dyadic products and matrices; gradients, divergence, curl, Laplacians; Stokes' integral theorem, Gauss theorem, conservation laws; curvilinear coordinates; tensors, material derivatives; applications of potential theory in electricity and magnetism, heat transfer, solid and fluid mechanics.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): MA 3160 and (MA 2320 or MA 2321 or MA 2330)

MA 4535 - Nonlinear Dynamics and Chaos
Ordinary differential equations and dynamical systems via a modern geometric approach, including physical and engineering applications. May include chaotic phenomena and fractals.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): (MA 3520 or MA 3521 or MA 3530 or MA 3560) and MA 3160
MA 4610 - Numerical Linear Algebra
Derivation and analysis of algorithms for problems in linear algebra. Covers floating point arithmetic, condition numbers, error analysis; solution of linear systems (direct and iterative methods), eigenvalue problems, least squares, singular value decomposition. Includes a review of elementary linear algebra and the use of appropriate software.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): MA 2320 or MA 2321 or MA 2330

MA 4620 - Numerical Methods for PDEs
Derivation, analysis, and implementation of numerical methods for partial differential equations; applications to fluid mechanics, elasticity, heat conduction, acoustics, or electromagnetism.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): (MA 3520 or MA 3521 or MA 3530 or MA 3560) and MA 3160

MA 4710 - Regression Analysis
Covers simple, multiple, and polynomial regression; estimation, testing, and prediction; weighted least squares, matrix approach, dummy variables, multicollinearity, model diagnostics and variable selection. A statistical computing package is an integral part of the course.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): MA 2710 or MA 2720 or MA 3710 or MA 3715

MA 4720 - Design and Analysis of Experiments
Covers construction and analysis of completely randomized, randomized block, incomplete block, Latin squares, factorial, fractional factorial, nested and split-plot designs. Also examines fixed, random and mixed effects models and multiple comparisons and contrasts. The SAS statistical package is an integral part of the course.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): MA 2710 or MA 2720 or MA 3710 or MA 3715

MA 4740 - Mathematical Statistics I
Covers joint probability distributions, functions of random variables, sampling and limiting distributions, introduction to parameter estimation.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): MA 3720

MA 4770 - Mathematical Statistics II
Continuation of MA4760. Theory of point and interval estimation; properties of estimators, theory of hypothesis testing, analysis of variance, analysis of categorical data and other topics as time allows.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): MA 4760

MA 4780 - Time Series Analysis and Forecasting
Statistical modeling and inference for analyzing experimental data that have been observed at different points in time. Topics include models for stationary and nonstationary time series, model specification, parametric estimation, and time regression models.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): MA 2710 or MA 2720 or MA 3710 or MA 3715

MA 4810 - Life Contingencies
Life tables. Basic forms of life insurance, life annuities, gross and net premiums, reserves, cash values, expense loadings, and commutation functions. Joint-life, last survivor, and reversionary functions. Derivative Securities, hedging. May include other topics on MLC and MFE exams.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2004-2005 academic year
Pre-Requisite(s): MA 3740 or MA 4710 or MA 4720 or MA 4780

MA 4820 - Loss Distributions and Credibility Theory
Loss distribution studies probability distributions that are used for modeling the outcomes of insurance claims. Credibility theory addresses methods for updating statistical estimates as new data becomes available. May include other topics on the C exam.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2005-2006 academic year
Pre-Requisite(s): MA 3720

MA 4900 - Mathematical Sciences Project
Independent study in an area of mathematical sciences under the guidance of a faculty member.
Credits: variable to 4.0; Repeatable to a Max of 6
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required

MA 4905 - Methods of Teaching Mathematics
This course focuses on trends and standards in secondary school mathematics education, with an emphasis on methods and materials for effectively supporting and assessing middle and high school learning. Requires admission to teacher education program.
Credits: 2.0
Lec-Rec-Lab: (0-1-2)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): ED 4700(C)

MA 4908 - Theory of Numbers with Technology
Mathematical induction, Euclid’s algorithm, prime and composite integers, algebra of congruences, Chinese remainder theorem, quadratic reciprocity law, number theoretic functions, first degree Diophantine equations, Pythagorean triples, Fermat and Mersenne numbers, factoring algorithms, tests for primality and various applications. Projects use Mathematica and EXCEL software packages.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Spring
Pre-Requisite(s): MA 3210 or MA 3310 or MA 3924

MA 4945 - History of Mathematics
Survey of the development of mathematics from ancient times to today. How cultural, mathematical, and technological developments have influenced one another throughout history. Course provides all necessary historical background.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): UN 1015 and UN 1025

MA 4990 - Topics in Mathematics
Students study in greater depth a particular area of mathematics not studied in existing courses.
Credits: variable to 4.0; Repeatable to a Max of 6
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required

Mechanical Engineering - Engineering Mechanics

MEEM 2110 - Statics
Force systems in two and three dimensions. Includes composition and resolution of forces and force systems, principles of equilibrium applied to various bodies, simple structures, friction, centroids, and moments of inertia. Vector algebra used where appropriate. Prerequisite of MA2160 with a grade of C or better is required.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following College(s): Sch of Forest Res & Envir Sci, College of Engineering
Pre-Requisite(s): MA 2160

MEEM 2150 - Mechanics of Materials
Introduction to mechanical behavior of materials, including stress/strain at a point, principle stresses and strains, stress-strain relationships, determination of stresses and deformations in situations involving axial loading, torsional loading of circular cross sections, and flexural loading of straight members. Also covers stresses due to combined loading and buckling of columns.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following College(s): Sch of Forest Res & Envir Sci, College of Engineering
Pre-Requisite(s): MEEM 2110
MEEM 2201 - Energy-Thermal-Fluids I
This course introduces concepts of energy, energy conversion, mechanisms of heat and work transfer in processes and in cycles.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following College(s): College of Engineering
Pre-Requisite(s): MA 2160 and CH 1150 and CH 1151

MEEM 2700 - Dynamics
First course in the principles of dynamics, covering the motion of a particle, the kinematics and kinetics of plane motion of rigid bodies, the principles of work and energy, impulse and momentum. Uses vector methods.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): PH 2100 and (MEEM 2110 or ENG 2120) and MA 3160(C)

MEEM 2901 - Mechanical Engineering Practice I
Students develop laboratory and computer skills. Topics include product dissection, data acquisition, materials testing, 2D finite element modeling, 1D modeling and simulation.

Credits: 2.0
Lec-Rec-Lab: (0-1-3)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Major(s): Mechanical Engineering
Pre-Requisite(s): MEEM 2110(C) and ENG 1102 and UN 1015 and (MA 2320(C) or MA 2321(C) or MA 2330(C))

MEEM 2911 - Mechanical Engineering Practice II
Students further develop laboratory and simulation skills as they model and validate dynamic mechanical and thermal/fluid systems. They also fabricate system components using a variety of manufacturing methods.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): MEEM 2901 and MEEM 2700(C)

MEEM 3000 - Mechanical Engg Laboratory
Presents basic laboratory skills, including analog and digital data acquisition, transducer selection and calibration, laboratory safety, and application of statistical principles to experimental data. Presents concept of investigating phenomenon through observation and interpretation of acquired data. Reinforces concepts in statics, strength of materials, thermodynamics, fluid mechanics, and dynamics.

Credits: 2.0
Lec-Rec-Lab: (0-1-3)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Major(s): Mechanical Engineering
Pre-Requisite(s): MEEM 2150 or ENG 2120 and MEEM 3230(C) and MEEM 3700(C) and EE 3010

MEEM 3201 - Energy-Thermal-Fluids II
This course expands on the concepts of energy transfer and conversion, heat transfer, fluid mechanics, and application of these concepts to processes, systems of processes and cycles.

Credits: 4.0
Lec-Rec-Lab: (0-4-0)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Major(s): Mechanical Engineering
Pre-Requisite(s): MEEM 2201 and MEEM 2911(C) and (MA 3520 or MA 3521 or MA 3530 or MA 3560)

MEEM 3210 - Fluid Mechanics
Presentation/development of the fundamentals of fluid dynamics, building on students' background in mechanics and thermodynamics. Makes applications to fluid statics, control-volume analyses, incompressible flows with friction (viscosity) and compressible flows without friction. Covers nondimensional representation of experimental results, power requirements for pumps and turbines, and energy losses in pipes.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring, Summer
Co-Requisite(s): MEEM 3220
Pre-Requisite(s): MEEM 2200 and MEEM 2700(C) and (MA 3520 or MA 3521 or MA 3530 or MA 3560)

MEEM 3220 - Energy Laboratory
Introduction to measurement techniques and the use of transducers to reinforce knowledge in the application of the principles of thermodynamics, fluid mechanics, and heat transfer.

Credits: 1.0
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Major(s): Mechanical Engineering
Co-Requisite(s): MEEM 3210
Pre-Requisite(s): MEEM 2200

MEEM 3230 - Heat Transfer
Covers fundamental principles of steady-state and transient heat transfer, including conduction, convection, and radiation. Also covers applications to heat exchangers and extended surfaces.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): MEEM 3210

MEEM 3400 - Mechanical System Design and Analysis
In this course, students learn mechanical synthesis and analysis methods. They use case studies to develop relationships between design and performance. They apply synthesis methods to the design of a new product.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): MEEM 2150 and MEEM 2700

MEEM 3501 - Product Realization I
Students apply mechanical synthesis, analysis, and manufacturing processes to the design of products, using case studies of existing products to develop the relationships between design, manufacturing, and product performance. They apply synthesis methods to the design of a new product.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): MEEM 2700 and MEEM 2150 and MEEM 2500 and (MA 2320(C) or MA 2321(C) or MA 2330(C))

MEEM 3502 - Product Realization II
Students apply design and manufacturing principles to a complete mechanical system, using synthesis and analysis software, SPC, design for manufacturing, and assembly techniques in the redesign of various consumer products.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): MEEM 3501 and (MA 3520(C) or MA 3521(C) or MA 3530(C))

MEEM 3600 - Introduction to Manufacturing
This course introduces manufacturing processes, including deformation, subtractive, additive, and molding processes. Students learn how things are made in both low and high production environments. It includes design for manufacturing considerations.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following College(s): School of Technology, College of Engineering
Pre-Requisite(s): MEEM 2150 and MY 2100

MEEM 3700 - Mechanical Vibrations

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): MEEM 2700 and (MA 2320 or MA 2321 or MA 2330) and (MA 3520 or MA 3521 or MA 3530 or MA 3560)

MEEM 3750 - Dynamic Systems
This course deals with the modeling, analysis and control of mixed physics systems. It covers differential equation generation for mechanical, thermal, and electrical systems, their simulation, and methods for analyzing their performance operating in both open and closed loop.

Credits: 4.0
Lec-Rec-Lab: (0-4-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Major(s): Mechanical Engineering
Pre-Requisite(s): MEEM 2700 and MEEM 2911 and (MA 3520 or MA 3521 or MA 3530 or MA 3560)
MEEM 3900 - Engineering Design Processes
This course introduces methods for concurrent design, manufacturing, and assembly that will be utilized later in their Senior Capstone Design or Enterprise project experience. Course topics will include thinking styles, teamwork, creative problem solving, brainstorming, Pugh method, technical report preparation, economic decision making, quality, analytical and experimental design optimization, DFA, DFM, GD&T, codes and fasteners, robust engineering, engineering ethics, patents and IP, and innovation in the workplace. A one semester 'paper only' design project is utilized to enhance the learning outcomes.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Major(s): Mechanical Engineering
Pre-Requisite(s): MEEM 2500

MEEM 3901 - Mechanical Engineering Practice III
Students go beyond modeling and validation to synthesize mechanical and thermal/fluids systems. They use experimental and simulation results to make design decisions. They select system parameters and components to meet design requirements.
Credits: 2.0
Lec-Rec-Lab: (0-1-3)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Major(s): Mechanical Engineering
Pre-Requisite(s): MEEM 2911 and MEEM 2150 and EE 3010(C)

MEEM 3911 - Mechanical Engineering Practice IV
Students further develop their skills to identify and solve ill-defined problems. They tackle a complex system problem by gathering evidence, proposing a solution, and iterating to optimize the solution.
Credits: 3.0
Lec-Rec-Lab: (0-2-3)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Major(s): Mechanical Engineering
Pre-Requisite(s): MEEM 3901 and MA 3710 and MEEM 3400(C) and MEEM 3600(C)

MEEM 3999 - Mechanical Engineering Undergraduate Research Project
An undergraduate research experience during the junior year in mechanical engineering. Students work directly with faculty on active research projects/grants. A report will be submitted and graded.
Credits: 3.0; Repeatable to a Max of 6
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required; Must be enrolled in one of the following Major(s): Mechanical Engineering; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Senior
Pre-Requisite(s): MEEM 3010 and MA 3710 and MEEM 3400(C) and MEEM 3600(C)

MEEM 4150 - Intermediate Mechanics of Materials
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): MEEM 2150

MEEM 4160 - Fund of Exp Stress Analysis
Transmits basic understanding of purposes and uses of experimental stress analysis and makes students familiar with methods used in the field to give experience in either design or analysis of strain-gauged transducers.
Credits: 3.0
Lec-Rec-Lab: (0-2-3)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): MEEM 2150

MEEM 4170 - Failure of Materials in Mechanics
Identifies the modes of mechanical failure that are essential to prediction and prevention of mechanical failure. Discusses theories of failure in detail. Treats the topic of fatigue failure extensively and brittle fracture, impact and buckling failures at some length.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): MEEM 3501

MEEM 4180 - Engineering Biomechanics
Engineering mechanics applied to the human body in health and disease or injury, which includes mechanics of human biological materials and engineering design in musculo-skeletal system. Also studies on mechanics of posture (occupational biomechanics) and locomotion (sports biomechanics) using mathematical models of the human body. Credit may not be received for both MEEM4190 and BE3750.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): MEEM 2150 and MEEM 2700

MEEM 4200 - Principles of Energy Conversion
Introduces basic background, terminology, and fundamentals of energy conversion. Discusses current and emerging technologies for production of thermal, mechanical, and electrical energy. Topics include fossil and nuclear fuels, thermodynamic power cycles, solar energy, wind energy, and energy storage. No credit for both MEEM4200 and MEEMS290.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): MEEM 3230(C) or CM 3230 or ENG 3200 or MY 3100

MEEM 4210 - Computational Fluids Engineering
Introduces computational methods used to solve fluid mechanics, and thermal transfer problems. Discusses theoretical and practical aspects. Modern computer-based tools are used to reinforce principles and introduce advanced topics in fluid mechanics, and thermal transport.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): MEEM 3230(C)

MEEM 4220 - Internal Combustion Engines I
Teaches the operation and design of various types of internal combustion engines through the application of applied thermodynamics, cycle analysis, combustion, mixtures of gases, fluid dynamics, and heat transfer.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): MEEM 3230(C)

MEEM 4230 - Compressible Flow/Gas Dynamics
Fundamentals of one-dimensional gas dynamics, including flow in nozzles and diffusers, normal shocks, frictional flows, and flows with heat transfer or energy release; introduction to oblique shocks.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): MEEM 3210

MEEM 4240 - Combustion & Air Pollution
Introduces sources of emissions from combustion, applies thermo-chemical principles to model the formation of pollutants, and identifies impacts of air pollutants on the environment and human health. Addresses pollution regulation and societal impacts including emissions, climate change, and air quality.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following College(s): College of Engineering; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior
Pre-Requisite(s): MEEM 2200

MEEM 4250 - Heating/Ventilation/Air Cond
Elements of heat transfer for buildings. Thermodynamic properties of moist air, human comfort and the environment, solar energy fundamentals and applications, water vapor transmission in building structures, heating and cooling load calculations.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2004-2005 academic year
Pre-Requisite(s): MEEM 3230(C)
MEEM 4260 - Fuel Cell Technology
In this course, after fuel cell technology basics and operating principles, fuel cell performance will be briefly described from energy and thermodynamic viewpoints. Major types of fuel cells will be discussed: Polymer Electrolyte Membrane Fuel Cell (PEMFC), Direct Methanol Fuel Cells (DMFC), Alkaline Fuel Cells (AFC), Phosphoric Acid Fuel Cell (PAFC), Molten Carbonate Fuel Cell (MCFC) and Solid Oxide Fuel Cell (SOFC). The balance of the fuel cell power plant, thermal system design and analysis will be discussed that affect the power generation. Finally, the components needed, issues related, and pertinent analysis will be covered to delivering electric power generated from the fuel cell.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following College(s): College of Engineering; Must be enrolled in one of the following Class(es): Senior
Pre-Requisite(s): MEEM 3230 or CM 3110

MEEM 4295 - Introduction to Propulsion Systems for Hybrid Electric Vehicles
Hybrid electric vehicle analysis will be developed and applied to examine the operation, integration, and design of powertrain components. Model based simulation and design is applied to determine vehicle performance measures in comparison to vehicle technical specifications. Power flows, losses, energy usage, and drive quality are examined over drive-cycles via application of these tools.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Summer
Restrictions: Must be enrolled in one of the following College(s): College of Engineering; May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): MEEM 2200 or ENG 3200

MEEM 4296 - Introduction to Propulsion Systems for Hybrid Electric Vehicles Laboratory
Hybrid electric vehicles and their powertrain components will be examined from the aspects of safety, testing and analysis, energy conversion, losses, and energy storage, and vehicle technical specifications and vehicle development process. The lab will culminate with vehicle testing to perform power flow and energy analysis during a drive-cycle.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Fall, Summer
Restrictions: Must be enrolled in one of the following College(s): College of Engineering; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

MEEM 4403 - Computer-Aided Design Methods
Students apply fundamental and advanced solid modeling techniques to construct solid models of mechanical systems, simulate the motion of the system, and document the design. Students use shared data to function in a concurrent design environment and identify major functional features of commercial CAD software.
Credits: 4.0
Lec-Rec-Lab: (3-0-2)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Major(s): Mechanical Engineering, Mechanical Eng-Eng Mechanics, Engineering-Manufacturing; May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): ENG 1102

MEEM 4404 - Mechanism Synthesis/Dynamic Modeling
Students apply kinematic synthesis techniques in design and analysis of mechanical systems. They develop synthesis software to link to dynamic analysis packages such as ADAMS, I-DEAS, Unigraphics, etc. They investigate influences of process variation on system output and learn methods to minimize the variation influences.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): MEEM 3502(C)

MEEM 4405 - Intro to the Finite Element Method
Introduces the use of the finite element method in stress analysis and heat transfer. Emphasizes the modeling assumptions associated with different elements and uses the computer to solve many different types of stress analysis problems, including thermal stress analysis and introductory nonlinear analysis.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): MEEM 3502 and (MA 2320 or MA 2321 or MA 2330) and (MA 3520 or MA 3521 or MA 3530 or MA 3560)

MEEM 4450 - Vehicle Dynamics
This course will develop the models and techniques needed to predict the performance of a road vehicle during drive off, braking, ride, and steering maneuvers. Topics to be covered include: acceleration and braking performance, drive train performance including an introduction to hybrid electric power train architecture, vehicle handling, suspension modeling, tire models, and steering control. Matlab will be used as a computational tool for implementation of the models.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following College(s): College of Engineering
Pre-Requisite(s): (MEEM 3502 and MEEM 3000) or (EE 3305 and MEEM 2700)

MEEM 4610 - Advanced Machining Processes
Covers mechanics of 2-D and 3-D cutting and their extension to commonly used conventional processes such as turning, boring, milling, and drilling. Topics include force modeling, surface generation, heat transfer, tool life and dynamics.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): MEEM 2500

MEEM 4615 - Metal Forming Processes
Covers analytical and experimental study of metal forming processes, such as forging, extrusion, rolling, bending, stretch forming, and deep drawing as well as progressive die design for sheet metal stamping and design of dies for bulk forming.
Credits: 4.0
Lec-Rec-Lab: (0-3-2)
Semesters Offered: Fall, Spring
Pre-Requisite(s): MEEM 2500 and MEEM 2150

MEEM 4625 - Precision Manuf and Metrology
Course presents theory and practice involved in manufacturing and measuring of precision components. Topics include precision machining processes, precision machine/mechanism design, and dimensional metrology. Also discusses current manufacturing challenges in the bearings, optics, and microelectronics industries.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Fall, Spring
Pre-Requisite(s): MEEM 3700(C) and MEEM 3502(C)

MEEM 4630 - Human Factors
The usability of products and systems can be improved by considering human capabilities during their design. This course explores both the psychological and physical characteristics of human beings. It then presents how to apply human factors principles to the design process. Degree credit cannot be received for both MEEM4630 and SSE3400.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): MEEM 3700(C) and MEEM 3502(C)

MEEM 4650 - Design with Plastics
Covers various complexities in design of plastic parts and design of molds for manufacturing of plastic parts.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): MY 2100 and MEEM 2150 and MEEM 3210 and MEEM 3230(C)

MEEM 4660 - Micromanufacturing Processes
Introduces the processes and equipment for fabricating microsystems and the methods for measuring component size and system performance. Fabrication processes include microscale milling, drilling, diamond machining, and lithography. Measurement methods include interferometry and scanning electron microscopy.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): MEEM 3502(C)

MEEM 4665 - Vehicle Performance
Introduces to the concepts and methods of quality and productivity improvement. Topics include principles of Shehart, Deming, Taguchi; measurement of quality; control charts for variables, individuals, and attributes; process capability analysis; variation of assemblies; and computer-based workshops. Credit may not be received for both MEEM4650 and MEEM5650.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): MA 3710 or MA 3720 or MA 2710 or MA 2720
MEEM 4655 - Production Planning
Provides coverage of fundamental production planning topics including scheduling, job design, inventory, and forecasting. Provides the fundamental essence of the firm—how its services and products are created and how they are delivered to customers.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): MEEM 3501(C)

MEEM 4660 - Data Based Modeling & Control
System modeling of observed data for computer-aided design and manufacturing, providing differential equation models. Analysis of manufacturing and dynamic systems, computer routines for modeling, forecasting with accuracy assessment, and minimum mean-squared error control. Underlying system analysis, including stability and feedback interpretation, periodic and exponential trends. Illustrative applications to real-life data.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

MEEM 4675 - Material Handling-Plant Layout
Basic background in material handling and plant layout for manufacturing, assembly, or warehousing. Emphasis is placed on the formulation and application experience in system design, plant layout, methods for solving design problems, and practical design issues. Insight is gained into the application of engineering design principles, performance calculations/analysis, and management concepts.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following College(s): College of Engineering, School of Business & Economics; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

MEEM 4685 - Env Resp Design & Manuf
Examines the impact of engineering and design/manufacturing, decisions on the environment. Topics include sustainability; energy and material flows; risk assessment; life cycles, manufacturing process waste streams, and product design issues, including disassembly and post-use product handling and techniques for pollution prevention.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2001-2002 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

MEEM 4700 - Dynamic Systems and Controls
Analysis of dynamic systems, use of Laplace transforms to solve differential equations, design of control systems using classical and modern approaches, comparison of control methodologies, application and comparison of time and frequency domain specifications to design, basic system identification, digital implementation issues. Emphasizes practical design and application issues.
Credits: 4.0
Lec-Rec-Lab: (0-3-2)
Semesters Offered: Fall, Spring
Pre-Requisite(s): MEEM 3700

MEEM 4701 - Analy and Exp Modal Analysis
Combined experimental and analytical approach to mechanical vibration issues; characterization of the dynamic behavior of a structure in terms of its modal parameters; digital data acquisition and signal processing; experimental modal analysis procedures; parameter estimation for obtaining modal parameters; model validation and correlation with analytical models; structural dynamics modification.
Credits: 4.0
Lec-Rec-Lab: (0-3-2)
Semesters Offered: Fall
Pre-Requisite(s): MEEM 3000 and MEEM 3700

MEEM 4704 - Acoustics and Noise Control
Analysis and solution of practical environmental noise problems. Fundamental concepts of sound generation and propagation, the unwanted effects of noise, assessment of sound quality, and source-path-receiver concepts in noise control. Lecture, measurement laboratory, and team project directed at solving a real noise problem under a client's sponsorship.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Spring
Pre-Requisite(s): MA 3160 and MEEM 2700

MEEM 4705 - Introduction to Robotics and Mechatronics
Cross-discipline system integration of sensors, actuators, and microprocessors to achieve high-level design requirements, including robotic systems. A variety of sensor and actuation types are introduced, from both a practical and a mathematical perspective. Embedded microprocessor applications are developed using the C programming language.
Credits: 4.0
Lec-Rec-Lab: (0-3-3)
Semesters Offered: Fall, Spring
Pre-Requisite(s): MEEM 4700(C)

MEEM 4720 - Space Mechanics
This course presents the vector-based solution of the two-body problem and the solution for Kepler's equations. The course will also cover basic orbit determination techniques, impulsive orbit transfer maneuvers, interplanetary trajectories, ground tracks, and rendezvous problems.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Restrictions: May not be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): MEEM 2700

MEEM 4750 - Distributed Embedded Control Systems
This course will develop an understanding of the design and application of embedded control systems. Topics to be covered include: embedded system architecture, model-based embedded system design, real-time control, communication protocols, signal processing, and human machine interface. Embedded applications in advanced hybrid electric vehicles will also be introduced.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following College(s): College of Engineering
Pre-Requisite(s): MEEM 4700 or EE 4261 or EE 3261

MEEM 4810 - Introduction to Aerospace Engineering
Introductory course on topics relevant to aerospace engineering and science. Topics include history, properties of the atmosphere, the solar system, atmospheric and space vehicles, mission design, and vehicle design and performance.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): (MEEM 2150 or ENG 2120) and (MEEM 3210 or ENG 3200)

MEEM 4901 - Senior Capstone Design I
Students work in teams on "open-ended" engineering capstone design projects - most with industrial sponsors - developing original and creative solutions to real engineering problems.
Credits: 2.0
Lec-Rec-Lab: (0-0-6)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Major(s): Mechanical Engineering, Civil Engineering
Pre-Requisite(s): MEEM 3000(C) and MEEM 3502(C) and MEEM 3900

MEEM 4911 - Senior Capstone Design II
Design project started in MEEM4901 are completed and evaluated using computer-aided engineering methods, physical models, and/or prototypes as appropriate.
Credits: 2.0
Lec-Rec-Lab: (0-0-6)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Major(s): Mechanical Engineering
Pre-Requisite(s): MEEM 4901 and MEEM 3000(C) and MEEM 3502(C) and MEEM 3900

MEEM 4990 - Special Topics in Mech Engg
Problems in mechanical engineering, engineering mechanics, manufacturing, or industrial engineering that are not covered in regular courses.
Credits: variable to 6.0; Repeatable to a Max of 6
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required; May not be enrolled in one of the following Class(es): Freshman, Sophomore

MEEM 4999 - Mechanical Engineering Senior Research Thesis
An undergraduate research experience during the senior year in mechanical engineering. Students begin work on an active research project/grant with faculty or continue work from the previous year. A thesis will be published in the department and archived.
Credits: 3.0; Repeatable to a Max of 6
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required; Must be enrolled in one of the following Major(s): Mechanical Eng-Eng Mechanics, Mechanical Engineering; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior
Mechanical Engineering Technology

MET 1020 - Technology Computer Applications
Introductory course intended to develop knowledge of computer modeling techniques such as solid modeling, spreadsheet, word processing, presentation, and project time line software utilized throughout the technology curriculum.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Fall, Summer

MET 1540 - Materials Science
Introduction to the fundamentals of materials. Introduces mechanical properties, phase diagrams, thermal processing, alloying, and corrosion. Examines material selection with regard to design considerations.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): CH 1000 or (CH 1150 and CH 1151)

MET 2120 - Statics and Strength of Materials
Statics includes the study of forces, analysis of simple structures, equilibrium, moment of inertia, and friction. Materials considers stress and strain under axial, torsional, and bending loads. Laboratory exercises include materials testing and problem solving.
Credits: 4.0
Lec-Rec-Lab: (0-3-2)
Semesters Offered: Fall
Pre-Requisite(s): (MA 1160(C) or MA 1161(C)) and (PH 1140 or PH 1110)

MET 2130 - Dynamics
Particle and rigid plane body kinematics and kinetics covers inertia force, work-energy-power and impulse-momentum methods. Emphasizes development of student skills in problem definition and problem solving.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): MET 2120

MET 2153 - Machine Tool Fundamentals and Applications
A study of basic machining processes; including setup and operation of lathes, milling machines, drill presses, grinders and saws. Students are exposed to fundamental machining processes, nomenclature and machine operation with an overall focus on safety and quality control.
Credits: 2.0
Lec-Rec-Lab: (0-1-3)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Major(s): Mechanical Engineering Tech

MET 2400 - Practical Applications in Parametric Modeling
Intermediate course intended to expand the student's knowledge of computer modeling techniques, introducing advanced assemblies and GD&T concepts. Investigates advanced concepts available to the designer.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Spring, Summer
Restrictions: Must be enrolled in one of the following Major(s): Mechanical Engineering Tech; Must be enrolled in one of the following Class(es): Sophomore
Pre-Requisite(s): MET 1020 or TE 1020

MET 3242 - Machine Design I
An introduction to mechanical design for technology students. The coursework applies principles of statics, dynamics and mechanics of materials to the design of simple mechanical components and systems.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): MA 2160 and MET 2130

MET 3250 - Applied Fluid Mechanics
An introduction to fluid mechanics for technology students. The coursework applies principles of statics and dynamics to the behavior of practical fluid-based components and systems. A laboratory complements the classroom learning.
Credits: 4.0
Lec-Rec-Lab: (0-3-2)
Semesters Offered: Fall
Pre-Requisite(s): MET 2130

MET 3451 - Machine Design II
This course extends the study of mechanical design begun in MET3242. Machine Design I and looks at more complex components and systems. Design projects are given special emphasis.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): MET 3242

MET 3500 - Manufacturing Processes
Focuses on practical aspects of design and manufacturing. Covers fundamentals of manufacturing processes and includes a weekly lab to provide hands-on experience with manufacturing issues that influence component design.
Credits: 4.0
Lec-Rec-Lab: (0-3-2)
Semesters Offered: Fall
Pre-Requisite(s): (MET 1020 or ENG 1102) and (MET 1540 or MY 2100)

MET 3600 - Applied Thermodynamics
Engineering thermodynamics principles including work, heat and temperature, pure substances, closed and open systems, first and second laws of thermodynamics, and power and refrigeration cycles.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): MET 3250

MET 4210 - Applied Quality Techniques
Basic knowledge required to improve processes in the workplace. Includes the design of simple experiments, statistical process control, lean methodologies, and corrective and preventative action. Not open to students with credit in EN3959, EN3967, MEE4650, or OSM4650.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): MA 2720(C) or MA 3710(C)

MET 4300 - Applied Heat Transfer
Heat transfer principles including conduction, convection and radiation heat transfer mechanisms. Practical applications include thermal insulation, heat sink and heat exchanger design.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): MET 3600

MET 4350 - Principles and Application of Heating, Ventilating, and Air Conditioning Systems
This course is designed to provide an introduction to heating, ventilating, and air conditioning systems that combines design principles with real-world applications. Students will conduct heating and cooling load calculations, learn psychrometrics, and have the opportunity to work on a realistic design project.
Credits: 3.0
Lec-Rec-Lab: (0-2-1)
Semesters Offered: Spring
Pre-Requisite(s): MET 4300

MET 4377 - Applied Fluid Power
An introduction to fluid power components and systems. The course includes component selection, circuit design, electrical interfaces, and system troubleshooting and maintenance. A laboratory exposes students to system hardware and circuit simulation techniques for mobile and industrial applications.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Spring
Pre-Requisite(s): MET 3250

MET 4380 - Alternative Energy Applications
An overview of world energy resources and energy consumption trends. Fundamental principles, applications and viability of alternative energy sources such as wind, solar, and tidal will also be presented.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): EET 2233

MET 4390 - Internal Combustion Engines
An introduction to the basic principles and applications of internal combustion engines. The course covers design, development and testing of engine components and systems. A laboratory exposes students to current industry methods.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Fall
Pre-Requisite(s): MET 3600 or MET 4300

MET 4440 - Reverse Engineering and Additive Manufacturing
This course is intended to develop an ability to apply foundational additive manufacturing principles and reverse engineering concepts. The focus will be on additive manufacturing inputs, technology, processes, materials, and industry trends. Includes projects utilizing scanning and 3D printing techniques.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): MET 2400

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MET 4460 - Product Design and Development
A treatment of design and development issues such as design for manufacturing, prototyping, industrial design, and customer needs. Presents integrated methodologies that examine marketing, manufacturing, and cross-functional teams. Includes concurrent engineering and projects utilizing CAD systems.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Fall, Spring
Restrictions: Permission of instructor required; Must be enrolled in one of the following Class(es): Junior, Senior

MET 4510 - Lean Manufacturing and Production Planning
Modern methods for the systematic planning and control of operations and an understanding of lean manufacturing concepts. Focus is on reducing lead times and elimination of waste. Not open to students with credit in MEEM4655 or OSM3000.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior

MET 4550 - Computer Aided Manufacturing
Course is designed to apply techniques used in parametric modeling (CAD) and convert this information to all phases of production planning, machining, scheduling and quality control.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior

MET 4560 - CAE and FEA Methods
Comprehensive use of both computer derived solutions and experimental validation of analytical and finite element solutions using methods such as strain gage testing.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): MET 2400 and MET 3451

MET 4670 - Senior Project
Completion and evaluation of design projects using computer-aided engineering methods, physical models, and/or prototypes. Evaluation and design optimization methods for efficient and cost-effective designs. Oral/written report and comprehensive exam.
Credits: 3.0
Lec-Rec-Lab: (0-0-6)
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required; Must be enrolled in one of the following Class(es): Senior
Pre-Requisite(s): MET 4460

MET 4780 - Advanced Manufacturing
An introduction to advanced manufacturing processes, both traditional and nontraditional. Study of both theory and practice will be tied to laboratory experiments utilizing a spectrum of unique materials and methods.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): MEEM 2500 or MET 3500

MET 4906 - Special Topics in Mechanical Engineering Technology
Selected additional topics of interest in Mechanical Engineering Technology based on student and faculty demand and interest. May be a tutorial, seminar, workshop, project, or class study.
Credits: variable to 3.0; Repeatable to a Max of 6
Semesters Offered: On Demand
Restrictions: Permission of instructor required; Must be enrolled in one of the following Major(s): Mechanical Engineering Tech; Must be enrolled in one of the following Class(es): Senior

MET 4997 - Independent Study in Mechanical Engineering Technology
Independent study of an approved topic under the guidance of a Mechanical Engineering Technology faculty member. May be either an academic, design, or research problem/project.
Credits: variable to 3.0; Repeatable to a Max of 6
Semesters Offered: On Demand
Restrictions: Permission of instructor required; Must be enrolled in one of the following Major(s): Mechanical Engineering Tech; Must be enrolled in one of the following Class(es): Senior

MET 4998 - Undergraduate Research in Mechanical Engineering Technology
An undergraduate research experience in Mechanical Engineering Technology. Under the guidance of a Mechanical Engineering Technology faculty member, students work on a selected/approved research problem or work directly with faculty on active research projects/grants. May require more than one semester to complete.
Credits: variable to 6.0; Repeatable to a Max of 6
Semesters Offered: On Demand
Restrictions: Permission of instructor required; Must be enrolled in one of the following Major(s): Mechanical Engineering Tech; Must be enrolled in one of the following Class(es): Senior

MET 4999 - Professional Practice Seminar
Course designed to review and evaluate the program objectives linked with industrial partners and accreditation body. Focus given to preparing the student to take the certification exam.
Credits: 1.0; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Class(es): Senior

Management

MGT 2000 - Team Dynamics and Decision Making
Develops individual and group problem-solving skills using active, hands-on learning. Emphasizes problem identification and problem solution under conditions of ambiguity and uncertainty. Stresses creativity, interpersonal skills and skill assessment, communication, group process and teamwork, and action planning.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: May not be enrolled in one of the following Class(es): Freshman

MGT 3000 - Organizational Behavior
Covers concepts of human relations and organizational behavior through the study of people's behavior at work. Develop understanding, attitudes, and skills leading to increased personal effectiveness.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: May not be enrolled in one of the following Class(es): Freshman

MGT 3100 - Leadership Development
Assesses students' current knowledge, abilities and values relevant to leadership and guides students in developing and implementing plans for new leadership abilities.
Credits: 3.0
Lec-Rec-Lab: (3-0-3)
Semesters Offered: Fall, Spring - Offered alternate years beginning with the 2008-2009 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman

MGT 3650 - Intellectual Property Management
Covers principles of intellectual property law, addressing managerial and policy issues in copyright, trademark, trade secret, and patents. Readings and discussions also cover how these property and legal systems impact the balance between property exclusivity, technological innovation and public access.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)

MGT 3800 - Entrepreneurship
Covers management issues associated with establishing a successful new enterprises as a small businesses or part of an existing firm. Emphasizes learning through creation of a business plan as well as case studies that develop an understanding of opportunity recognition, entrepreneurial teams, reward systems, financing alternatives, family ventures, ethical and legal contractual considerations, and resource needs.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

MGT 3900 - Entrepreneurship
Covers management issues associated with establishing a successful new enterprises as a small businesses or part of an existing firm. Emphasizes learning through creation of a business plan as well as case studies that develop an understanding of opportunity recognition, entrepreneurial teams, reward systems, financing alternatives, family ventures, ethical and legal contractual considerations, and resource needs.
MGT 4000 - Strategic Management
A capstone course focusing on managing from a strategic perspective for gaining advantages in competitive and dynamic environments, emphasizing understanding of industry, business models, growth strategies, and managing business portfolios. Integrates knowledge from finance, marketing, and organizational behavior.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following College(s): School of Business & Economics; Must be enrolled in one of the following Class(es): Senior
Pre-Requisite(s): MIS 2000 and FIN 3000 and OSM 3000 and MGT 3000 and BUS 2300

MGT 4100 - International Management
Addresses the complexities and challenges faced by companies operating in an increasingly globalized world. Focuses on political, legal, ethical, cultural, economic issues, and on the entry, growth and knowledge management strategies of developed and developing country firms.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): MGT 3000 and EC 3100(C)

MGT 4200 - Entrepreneurial Management
Draws upon the fundamental concepts of entrepreneurship covered in MGT3800 (Entrepreneurship) and enhances the understanding of these concepts from a strategic and entrepreneurial management point of view.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): MGT 3000 and MGT 3800

MGT 4500 - Managing Change in Organizations
Studies organizational theory with an emphasis on managing change in organizations. Examines forces for change in the external environment, methods for managing change (design and implementation), the impact of change on people, and leaders as agents of change. Case studies and student projects prepare the student to manage change in organizations.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2012-2013 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): MGT 3000

MGT 4600 - Management of Technology and Innovation
Introduces disruptive innovation concepts and provides occasions for their application to timely and relevant cases. Provides an understanding of technology management and innovation processes as they occur inside and outside of organizations.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): MGT 3000

MGT 4700 - Human Resource Management
Examines methods that organizations use to meet organizational goals through influencing worker attitudes, behaviors, and performance. Topics include recruitment, selection, training, performance appraisal, and compensation.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): MGT 3000

MGT 4900 - Special Topics in Management
Examines additional management topics and issues in greater depth. A single offering of this course will concentrate on one or two topics which vary.
Credits: variable to 3.0; Repeatable to a Max of 6
Semesters Offered: On Demand
Restrictions: Permission of instructor required
Pre-Requisite(s): MGT 3000

Management Information Systems

MIS 2000 - IS/IT Management
Focuses on the theory and application of the information-systems discipline within an organizational context, and identifies the roles of management, users, and information systems professionals. Covers the use of information systems and implications for decision support to improve business processes, and addresses the ethical, legal, and social issues of IT.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): BUS 1100 or CS 1121 or CS 1131 or ENG 1101 or (ENG 1001 and ENG 1100) or SAT 1200

MIS 2100 - Introduction to Business Programming
Develops business problem solving skills through the application of a commonly used high-level business programming language. Topics include the nature of the business programming environment, fundamentals of the language (e.g., programming constructs, data management, manipulation of simple data structures), structured programming concepts, desirable programming practices and design, debugging and testing techniques.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring

MIS 2200 - Web Programming
Covers technologies, tools, and environments related to the development of web-enabled business solutions. Topics include the development environment for web-based solutions, key development technologies, desirable development practices, and design, programming, debugging and testing methods.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): MIS 2100 or CS 1121 or CS 1131

MIS 3000 - Business Process Analysis
Studies business decision management discipline using business rules, process models (e.g. flowcharts, unified modeling language, swim lanes), and information systems to improve efficiency and effectiveness. Emphasis on industry standards and business process management used to increase productivity.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2011-2012 academic year
Pre-Requisite(s): MIS 2000

MIS 3100 - Business Database Management
Emphasizes database principles that are constant across different database software products through concrete examples using a relational database management system. Provides a well-rounded business perspective about developing, utilizing, and managing organizational databases.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): MIS 2000(C)

MIS 3200 - Systems Analysis and Design
Provides an understanding of the IS development and modification process and the evaluation choices of a system development methodology. Emphasizes effective communication with users and team members and others associated with the development and maintenance of the information system. Stresses analysis and logical design of departmental-level information system.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): MIS 2000(C)

MIS 3300 - Telecommunications
Introduces students to telecommunications concepts, architectures and protocols, commercial offerings, hardware, software, network design, and telecommunications management, regulations, and business applications (e-commerce).
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2012-2013 academic year
Pre-Requisite(s): MIS 2000(C)
### Materials Science & Engineering

**MY 2100 - Introduction to Materials Science and Engineering**
Introduction to the structure, processing, properties, and performance of engineering materials, including metals, polymers, glasses, ceramics, and composites. Presents case studies covering selection of materials, component design, and analysis of component failures.

**Credits:** 3.0  
**Lec-Rec-Lab:** (3-0-0)  
**Semesters Offered:** Fall, Spring  
**Pre-Requisite(s):** CH 1112 or CH 1122 or (CH 1150 and CH 1151) or (CH 1160 or CH 1161)

**MY 2110 - Introduction to Materials Science and Engineering II**
Continuation of MY2100 designed to address "core competencies" in the materials discipline. Materials processing methods are used as a vehicle to master concepts such as conservation principles, crystallography, imperfections, phase diagrams, microstructure, and develop mathematical skills and introduce computational tools.

**Credits:** 3.0  
**Lec-Rec-Lab:** (0-2-3)  
**Semesters Offered:** Fall, Spring  
**Pre-Requisite(s):** MY 2100

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### Marketing

**MKT 3000 - Principles of Marketing**
Emphasizes decisions made in developing both strategic and tactical marketing plans. Uses computer simulations, experiential learning assignments, and marketing plan development to demonstrate principles of market segmentation, product development, pricing, distribution planning, and promotion.

**Credits:** 3.0  
**Lec-Rec-Lab:** (3-0-0)  
**Semesters Offered:** Fall, Spring, Summer  
**Restrictions:** May not be enrolled in one of the following Class(es): Freshman

**MKT 3200 - Consumer Behavior**
Introduces students to the general concepts, processes, and variables pertinent to consumers' decision making and lifestyle choices. Discussions will be based on a variety of disciplines: psychology, sociology, economics, and anthropology.

**Credits:** 3.0  
**Lec-Rec-Lab:** (3-0-0)  
**Semesters Offered:** Fall  
**Pre-Requisite(s):** MKT 3000

**MKT 3400 - Integrated Marketing Communications**
Discusses how a variety of marketing communication methods, such as advertising, public relations, sales promotion, point-of-purchase, and direct marketing are developed, implemented, and evaluated in an integrative manner.

**Credits:** 3.0  
**Lec-Rec-Lab:** (0-3-0)  
**Semesters Offered:** Spring  
**Pre-Requisite(s):** BA 3800 or MKT 3000
MY 3100 - Materials Processing I
Classical chemical thermodynamics as applied to single and multicomponent materials systems. Topics include heat and mass balance, enthalpy, entropy, free energy, chemical reactions and equilibria, mass action, solution thermodynamics, phase diagram, stability/Pourbaix diagrams and electrochemistry.
Credits: 4.0
Lec-Rec-Lab: (4-0-0)
Semesters Offered: Fall
Pre-Requisite(s): MY 2100 and MA 2160

MY 3110 - Materials Processing II
A continuation of Materials Processing I, which introduces the fundamental theories and equations governing transport phenomena. Topics include fluid flow, heat flow, diffusion, and chemical kinetics. Discusses the relationships between these subjects and the thermodynamic concepts covered in Materials Processing I.
Credits: 4.0
Lec-Rec-Lab: (4-0-0)
Semesters Offered: Spring
Pre-Requisite(s): MY 2110 and MY 3100 and (MA 3520 or MA 3521 or MA 3530 or MA 3560)

MY 3200 - Materials Characterization I
Fundamentals of microstructural and chemical characterization of materials. Examines the physical principles controlling the various basic characterization techniques. Topics include crystallography, optics, optical and electron microscopy, and diffraction. Laboratory focuses on proper operational principles of characterization equipment, which includes optical and other microscopy methods and various diffraction techniques.
Credits: 4.0
Lec-Rec-Lab: (2-1-3)
Semesters Offered: Fall, Spring
Pre-Requisite(s): MY 2100 and MY 2110

MY 3210 - Materials Characterization II
Fundamentals of structural characterization. A continuation of Materials Characterization I which examines additional structural techniques such as thermal analysis, calorimetry, and particulate analysis, scanning tunneling, spectroscopy, and atomic force microscopy. Discusses the limitations/capabilities of basic characterization techniques as well as data analysis methods and practices.
Credits: 3.0
Lec-Rec-Lab: (2-1-3)
Semesters Offered: Fall, Spring
Pre-Requisite(s): MY 2100

MY 3300 - Design of Microstructure
Relates thermodynamic and kinetic principles to phase transformations and microstructural evolution. Topics include nucleation, solidification, precipitation, recrystallization, grain growth, and sintering. Applications of these concepts (e.g., heat treatment of steel, casting, powder processing, etc.) are presented and reinforced by laboratory exercises in the corequisite course Materials Characterization II.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Pre-Requisite(s): MY 2110 and MY 3100 and MY 3200(C)

MY 3701 - Introduction to Semiconductor Materials Science and Engineering
An introduction to the materials science and engineering of semiconductors. Topics include semiconductor material electronic, thermal, and optical properties, how these properties are modified, how elementary devices made from these materials operate, and how device function depends on materials selection and processing.
Credits: 2.0
Lec-Rec-Lab: (2-0-0)
Semesters Offered: Fall
Pre-Requisite(s): PH 2400

MY 4130 - Principles of Metal Casting
Principles of metal casting, including melting practice, casting design, mold design, heat transfer and solidification, fluid flow and gating design, introduction to computer simulation techniques for mold filling, solidification, and development of residual stress. Structure-property relations in cast metals. Recycling and environmental issues of the cast metals industry.
Credits: 3.0
Lec-Rec-Lab: (2-0-3)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): MY 2100

MY 4140 - Science of Ceramic Materials
The structure, defect chemistry, and properties of crystalline and amorphous ceramics. Utilization of these materials in a variety of applications such as electrolytes in fuel cells and as bioceramics are examined.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Pre-Requisite(s): MY 2100

MY 4155 - Composite Materials
Mechanistic aspects of property development in metal, ceramic, and polymeric composites. The role of composite architecture, processing, and microstructure on properties.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): MY 2100

MY 4165 - Corrosion and Environmental Effects
Mechanisms of corrosion processes, electrochemical and oxidation kinetics, and fundamentals of corrosion engineering.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): MY 2100

MY 4180 - Advanced Physical Metallurgy
Examines what exactly makes a particular industrial alloy useful. From the light metals (aluminum, magnesium and titanium) to the heavy weights (nickel and high alloy steels), this course examines the structure, properties, and processing of metals into industrially useful materials. Covers internationally accepted alloy designations, heat treatment standards, modification and processing.
Credits: 3.0
Lec-Rec-Lab: (2-1-0)
Semesters Offered: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior
Pre-Requisite(s): MY 2100 and MY 3300

MY 4190 - Environmental Engineering for Materials Processing Industries
Assessment and analysis of environmental impacts from materials processing industries. Regulations, permits, and industrial practices for monitoring and solving air, water, and solid environmental issues. Pollution prevention. Life cycle analysis. Material flow analysis.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

MY 4200 - Introduction to Scanning Electron Microscopy
Introduction to scanning electron microscope (SEM) theory and application. Topics will include electron beam and image formation, beam-specimen interactions, and x-ray microanalysis. Course material will be of interest to biologists, chemists, and engineers. Completion of MY4201 is required for independent use of the equipment.
Credits: 2.0
Lec-Rec-Lab: (2-0-0)
Semesters Offered: Fall, Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

MY 4201 - Introduction to Scanning Electron Microscopy Laboratory
A laboratory course providing hands-on practical training leading to independent use of the scanning electron microscope (SEM).
Credits: 1.0
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Major(s): Materials Science and Engineering
Pre-Requisite(s): MY 4200(C)

MY 4220 - Materials Forensics
Probes the fundamental physical principles important to the various characterization techniques used to understand the structure, microstructures, and substructures in materials. Application of x-ray, electrons, and light to unravel the structural mystery of materials. Topics include crystallography, quantitative microscopy, x-ray diffraction, scanning electron microscopy, and chemical analysis by optical and x-ray emission spectroscopy.
Credits: 3.0
Lec-Rec-Lab: (2-0-3)
Semesters Offered: Fall
Co-Requisite(s): MY 2100, MY 3200

MY 4240 - Introduction to MEMS
Fundamentals of micromachining and microfabrication techniques, including planar thin-film process technologies, photolithographic techniques, deposition and etching techniques, and the other technologies that are central to MEMS fabrication.
Credits: 4.0
Lec-Rec-Lab: (3-1-0)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior
MY 4292 - Light and Photonic Materials
Material properties controlling light wave propagation in optical crystals and optical wave guides. Photonic crystals and photonic devices based on electrical, magnetic, and strain effects.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Major(s): Physics, Applied Physics, Electrical Engineering, Materials Science and Engrg; Must be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): PH 2200 or EE 2190 or EE 3140

MY 4300 - Mechanical Behavior of Materials
An introduction to the deformation and fracture behavior of materials. Topics include multiaxial stress and strain, elastic and plastic deformation, hardening mechanisms, viscoelasticity, fracture, fatigue, creep, and microstructure/property relationships.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Pre-Requisite(s): MY 2110 and MY 2100 and (MEEM 2150 or ENG 2120)

MY 4310 - Practical Scanning Probe Microscopy for Undergraduates
In this course, students will learn the design and fundamental physics behind scanning probe microscopy (SPM) techniques. Laboratories will include basic training in the operation of SPM instruments available at MTU, and the exploration of their capabilities during assigned team projects.
Credits: 1.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: On Demand - Offered alternate years beginning with the 2011-2012 academic year
Restrictions: Permission of instructor required; May not be enrolled in one of the following Class(es): Freshman

MY 4600 - Introduction to Polymer Engineering
Basics in polymer science including molecular characteristics, synthesis, structure and properties of polymers. Various processing techniques and mechanical/structural applications of polymers.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Pre-Requisite(s): MY 2100

MY 4610 - Computational Materials Science: Theory, Modeling, Simulation, and Practice
Theories of materials science from first principles to constitutive laws. Materials modeling and computer simulation at multiple length and time scales. Laboratory practice of various computational methods.
Credits: 3.0
Lec-Rec-Lab: (2-0-3)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

MY 4740 - Hydrometallurgy/Pyro metallurgy
Extraction and refining of metals and industrial chemicals from natural and recycled materials. Includes solution-chemistry processes (hydrometallurgy) and thermochemical processes (pyrometallurgy).
Credits: 4.0
Lec-Rec-Lab: (3-1-0)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): CH 1122 or (CH 1160 and CH 1161)

MY 4777 - Distributed Additive Manufacturing Using Open-Source 3-D Printing
This course provides an overview of open-source hardware in theory and practice for an introduction to distributed additive manufacturing using open-source 3-D printing. Each student will build a customized RepRap and will learn all hardware and software for maintaining it.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following College(s): College of Engineering; Must be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): MY 2100

MY 4800 - Material and Process Selection in Design
The principles of materials selection for engineering design. Topics include selection based on strength, stiffness, thermal properties, high temperature behavior, corrosion resistance, formability, joinability, manufacturability, recyclability, etc. Considers ethics and economics. Presents numerous case studies and examples.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Pre-Requisite(s): MY 2100

MY 4920 - Materials Science & Engineering Senior Design Project I
Conducted in teams of students working with industrial partners. Open to all engineering majors interested in interdisciplinary senior design projects. Non-MSE majors must be senior project ready as defined by their major program and obtain permission of the MSE department.
Credits: 2.0
Lec-Rec-Lab: (0-0-6)
Semesters Offered: Fall, Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior
Pre-Requisite(s): MY 3110 and MY 3200 and MY 3210 and MY 3300 and MY 4940(C)

MY 4930 - Materials Science & Engineering Senior Design Project II
Senior design project conducted in teams of students working with an industrial partner. Open to all engineering majors interested in interdisciplinary senior design projects. Senior project ready as defined by major substitutes for prerequisites.
Credits: 2.0
Lec-Rec-Lab: (0-0-6)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

MY 4940 - Material Design
Integration of contemporary engineering design methodology with foundational structure-property-processing paradigm for materials design. Introduction to project planning, management, and six-sigma as applied to material design.
Credits: 2.0
Lec-Rec-Lab: (1-0-2)
Semesters Offered: Spring
Pre-Requisite(s): MY 3100 and MY 3110(C) and MY 3200(C) and MY 3210(C) and MY 3300(C) and ENG 1102

MY 4970 - Special Topics - Materials
Special topics in materials science and engineering.
Credits: variable to 4.0; May be repeated
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required

MY 4990 - Undergraduate Research
Undergraduate research in materials science and engineering. Independent research conducted under the guidance of a faculty member.
Credits: variable to 6.0; May be repeated
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required

Operations & Supply Chain Management

OSM 3000 - Operations and Supply Chain Management
Fundamental principles of operations and supply chain management; includes strategic importance and relevant interrelated concepts and tools in product/process design, work systems, forecasting, inventory and materials management, just-in-time, scheduling, and capacity management.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): (MA 1135 or MA 1160 or MA 1161) and (MA 2710 or MA 2720 or MA 3710 or MA 3720 or EET 2010 or BUS 2100)

OSM 3150 - Introduction to Supply Chain Management
An introduction to supply chain management to gain a perspective on integration and coordination issues. Topics include strategy, network design, facility design, sourcing, logistics, forecasting, inventory, relationship management, and global and sustainable supply chain management.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): OSM 3000

OSM 3200 - Project Management
Focuses on application of systems analysis to project definition and selection. Covers project teams, their structures, and interactions; cross-functional communication in technological project management; project management planning, scheduling, and control tools; project monitoring, evaluation, and termination; multiple project management and inter-project relations.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): MA 2710 or MA 2720 or MA 3710 or EET 2010 or BUS 2100
OSM 3600 - Procurement and Supply Management
Addresses processes that facilitate the management of value added transactions and relationships between supplier and customer organizations. The course examines the management of the business purchasing function, including supplier selection and development, cost management, performance measures, buyer-supplier relationships, and negotiation.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): (MA 2720 or MA 3710) and (MA 1135 or MA 1160 or MA 1161)

OSM 4100 - Global Operations Strategy
Addresses issues in operations management, quality, finance/accounting, marketing, supply chain, and technology to provide an interdisciplinary focus on strategic planning for operations. Also addresses issues associated with global initiatives and changing technology.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand - Offered alternate years beginning with the 2002-2003 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): OSM 3000

OSM 4150 - Advanced Supply Chain Management
Advanced topics in supply chains including forecasting methods, inventory control, facility location, routing of physical flows among facilities, aggregate planning, contracts, and distribution and network design. Includes the use of spreadsheet modeling tools to solve complex supply chain problems.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): BUS 2300 and OSM 3150

OSM 4200 - Advanced Project Management
A project oriented business development class focused on real-life and advanced applications of project management techniques. Students participate in a competition, prepare for the PNI CAPM exam, and may sit for the exam to obtain certification.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): OSM 3200 or OSM 4300 or SSE 4300

OSM 4650 - Six Sigma Fundamentals
Course is framed in context of six sigma methodology. Topics include principles of Shewhart, Deming, Taguchi; meaning of quality; control charts for variables, individuals, and attributes; process capability analysis; variation of assemblies; and computer-based workshops.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): MA 2710 or MA 2720 or MA 3710 or MA 3720 or BUS 2100

OSM 4700 - Logistics and Transportation Management
Focuses on the transportation and distribution services that support demand fulfillment from the receipt of customer orders to order fulfillment. Topics include customer service, order fulfillment, inventory, transportation costs and modes, facility design and operation, carrier selection, and negotiation.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): (MA 2710 or MA 2720 or MA 3710) and (MA 1135 or MA 1160 or MA 1161)

Physical Education

PE 0101 - Flag Football
Fundamental skills and rules will be learned for co-recreational play of flag football. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Summer

PE 0103 - Bait and Fly Casting
Bait and fly casting skills. Each student must have a valid current year Michigan fishing license. Trout stamp is optional. Equipment is available if needed. Requires some additional hours outside of class. May be use once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: On Demand

PE 0104 - Ultimate Frisbee
Fundamental skills, rules, and play of ultimate frisbee. The class is physically strenuous. Frisbees are provided. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Summer

PE 0105 - Beginning Bowling
Fundamental skills, rules, and scoring of bowling. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring

PE 0106 - Beginning Golf
Rules, terminology, and etiquette of golf and the individual skills of grip, stance, and swing. Equipment is supplied. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Spring

PE 0107 - Floor Hockey
Individual skills, team techniques, rules and strategies of floor hockey. Hockey gloves or winter gloves are highly recommended. Sticks and goalie equipment are provided. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Spring

PE 0108 - Broomball
Students will learn the rules, strategy, and safety needed to compete in broomball. Offensive and defensive zone coverages and individual skills are stressed. Team play with official. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Spring

PE 0109 - Aikido
Aikido is a specific martial arts training for physical and character development. Physically strenuous. Students should wear loose sweatsuits (with long sleeves) or white martial arts uniform. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring

PE 0111 - Disc Golf
Fundamental skills, rules and play of disc golf. Students will learn recreational play and organized tournament play (various formats). Students can bring their own disc (or discs); some are provided. The class meets at MTU's Disc Golf Course on Sharon Avenue by the Advanced Technology Development Complex. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring

PE 0114 - Frisbockey
Fundamental skills, rules and play of frisbockey will be taught. Class is physically strenuous. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Summer

PE 0115 - Beginning Swimming
Nonswimmers learn to have no fear of water, to float, and to swim the four fundamental strokes. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: On Demand

PE 0116 - Beginning Basketball
Theory, organization, and defensive and offensive skills of basketball. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Spring
PE 0117 - Beginning Hockey
Individual skills, team techniques, rules, and strategies. Requires basic hockey equipment of helmet with face mask, shoulder pads, hockey pants, shin pads, elbow pads, hockey gloves, skates, supporter, jersey, hockey socks, hockey stick. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring

PE 0118 - Beginning Weight Training
Training methods for physical development using stationary and free weights. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring, Summer

PE 0119 - Beginning Fitness Training
This course is designed to introduce students to a variety of activities to improve their fitness and well being. Activities will include using aerobic machines and strength training. Students will learn the basic concepts of fitness and how to safely and properly use the fitness center equipment.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring

PE 0120 - Beginning Alpine Skiing (Downhill)
Beginning skills of alpine skiing techniques taught, evaluated, and recommendations made for improvement. Students with skills above beginner level cannot take this class. Students must provide their own transportation to Mont Ripley. It is recommended that students provide their own equipment. Daily rental and "rent for the season" equipment available at Mont Ripley.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Spring

PE 0121 - Beginning Snowboarding
Beginning skills of snowboarding techniques taught, evaluated, and recommendations made for improvement. Students must be a beginner or have never snowboarded to this class. Students with skills above beginner level cannot take this class. Students must provide their own transportation to Mont Ripley. It is recommended that students provide their own equipment. Daily rental and "rent for the season" equipment available at Mont Ripley. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Spring

PE 0122 - Softball
Fundamentals of throwing, fielding, and hitting a softball. Bats, balls, and bases are provided. Each student must bring a glove. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Summer

PE 0123 - Telemark Skiing
The beginning skills of Telemark skiing techniques will be taught, evaluated and recommendations made for improvement. Students must provide own transportation and Telemark ski equipment. A limited amount of rentals are available.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Summer

PE 0125 - Sand Volleyball
Sand volleyball rules, basic fundamentals and team play. Passing, setting, attacking, serving, blocking, round robin, 2 vs. 2, and 4 vs. 4 tournaments, 6 vs. 6 system and drills to improve one's overall play. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Spring

PE 0126 - Beginning Volleyball
Fundamental skills, rules interpretation, strategy, and conduct of tournament play. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Summer

PE 0127 - Beginning Archery
Students will demonstrate the fundamental knowledge and skills of archery, safety, and care of equipment necessary for its enjoyment and participation as a lifelong activity. One dozen arrows must be supplied by the student (available for purchase on campus). May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: On Demand

PE 0130 - Water Aerobics
Improvement of fitness and body measurement through water exercise. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall

PE 0132 - Beginning Soccer
Fundamental skills, techniques, terminology, and rules of soccer. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Summer

PE 0135 - Beginning Cross Country Skiing
Develop the skills for touring/recreational cross-country skiing. Own equipment is recommended; rental equipment available. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Spring

PE 0137 - Table Tennis
Fundamental skills of table tennis will be taught. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring

PE 0138 - Beginning Racquetball/Squash
Fundamentals, rules, and basic strategies of racquetball/squash. Gives students opportunity to play singles, cutthroat, and doubles. Racquets, balls, and eyewear provided. Recommend use of personal racquet. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring

PE 0139 - Beginning Badminton
Fundamental skills, rules, and scoring of badminton. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring

PE 0140 - Beginning Tennis
Fundamentals of the game, rules, and etiquette of tennis. Meets at Gates Tennis Center. Non-marking court shoes must be worn. Tennis balls and raquets provided. Recommend use of personal racquet. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring

PE 0145 - Beginning Rifle
Using precision air rifles, beginners develop an awareness of firearms safety and marksmanship. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring

PE 0146 - Beginning Billiards
Introduction to the etiquette, rules, and recreational value of pocket billiards. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring

PE 0150 - Outdoor Lifetime Activities
This class will introduce students to a variety of recreational activities often used in a social/leisure setting (i.e., shuffleboard, billiards, table tennis, etc.). May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Summer

PE 0151 - Indoor Lifetime Activities
This class will introduce students to a variety of recreational activities often used in a social/leisure setting (i.e., shuffleboard, billiards, table tennis, etc.). May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Spring
PE 0152 - Social Dance I
Fundamentals of social dance, providing the basic skills, concepts of movement, style, and fundamental step patterns. Emphasis on the development of fundamental dance skills and practice in utilizing dance techniques.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring

PE 0153 - Aerobics I
Improvement of cardiovascular fitness, strength, coordination, and body mechanics through exercise. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring

PE 0155 - Beginning Road Biking
Learn to be comfortable and confident while riding a regular road bike. Covers basic maintenance repair procedures. Requires own equipment and supplies, including a bike helmet. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall

PE 0156 - Beginning Mountain Biking
Learn to be comfortable and confident while riding a mountain bike off-road. Covers basic maintenance repair procedures. Requires own equipment and supplies as well as a biking helmet. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall

PE 0165 - Rowing
Basic movement at your own level. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: On Demand

PE 0166 - Moving for Fitness
Introductory course to using the Student Development Complex and surrounding outdoor facilities in a variety of group and individual activities. Basic movement at your own level. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Summer

PE 0167 - Beginning Yoga
Learn the basics or compliment previous experience while improving flexibility, balance and concentration. Improve focus. Relax mentally and physically.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring

PE 0168 - Beginning Pilates
Students will learn a unique approach to exercise that develops body awareness. Pilates is one of the safest forms of exercise today. Students will improve coordination, posture and flexibility, as well as, release stress. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring

PE 0169 - Spinning
High energy, group cycling class. No complicated moves to learn. Upbeat music that gets your legs pumping.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring

PE 0170 - TaekWoonDo and Hapkido I
Introduction to the basic kicking, blocking, punching, joint locking, and self-defense techniques of TaekWoonDo and Hapkido. Emphasizes improvement of flexibility. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring

PE 0175 - Hiking
Fundamental knowledge and skills specific to hiking will be covered. Appropriate clothing and footwear for hiking is recommended. Course meets on weekends (usually Saturdays). May be used once as a general education co-curricular course. Due to class structure, students must attend all classes - No Exceptions.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Summer

PE 0176 - Outdoor Adventure
Students will engage in multi-day backpacking with overnight camping. Destinations are variable, possibilities include Isle Royale National Park, Porcupine Mountains, etc. Instructors will include trained wilderness guides and class/laboratory fee will cover miscellaneous costs such as park permits, transportation costs, camping gear, and group meals.
Credits: variable to 3.0; Repeatable to a Max of 3; Graded Pass/Fail Only
Semesters Offered: On Demand

PE 0200 - Fitness Foundations
Students will be introduced to practices and physical activities that they can incorporate into their daily life to sustain their healthy body and mind.
Credits: 1.0; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring

PE 0205 - Intermediate Bowling
Intermediate to advanced techniques in bowling, including skills and strategy involved in tournament play. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring

PE 0206 - Intermediate Golf
Intermediate to advanced individual instruction in golf techniques, terms, courtesies, and tournament regulations. Equipment needed; some rental clubs available. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Summer

PE 0209 - Intermediate Aikido
This course is designed to be a continuation of Aikido.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: On Demand

PE 0210 - Special Topics in Physical Education
Unconventional activity courses that address varying and changing student interests. Topics vary. Each topic may count once as a general education co-curricular course as long as the topic and course content are different than other co-curricular courses taken.
Credits: 0.5; Repeatable to a Max of 1; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring, Summer

PE 0215 - Intermediate Swimming
Students learn to swim four basic strokes with proficiency. Requires ability to swim the length of pool comfortably. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring

PE 0216 - Intermediate Basketball
Intermediate to advanced techniques, skills, and strategies of basketball. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall

PE 0217 - Intermediate Hockey
Intermediate/advanced techniques, skills, and strategies. Requires basic hockey equipment of helmet with face mask, shoulder pads, hockey pants, shin pads, elbow pads, hockey gloves, skates, supporter, jersey, hockey socks, hockey stick. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring

PE 0218 - Intermediate Weight Training
Intermediate to advanced techniques of weight lifting. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring

PE 0219 - Intermediate Fitness Training
This course is designed to be a continuation of Beginning Fitness Training, providing the opportunity to continue in a variety of activities to improve fitness and well being. Activities include using aerobic machines and strength training. Students will learn fitness training concepts and how to safely and properly use fitness center equipment.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring
PE 0220 - Intermediate Alpine Skiing (Downhill)
Intermediate to advanced skills of alpine skiing techniques taught, evaluated and recommendations made for improvement. Students must provide their own transportation to Mont Ripley. It is recommended that students provide their own equipment. Daily rental and "rent for the season" equipment available at Mont Ripley. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Spring

PE 0221 - Intermediate Snowboarding
Intermediate to advanced skills of snowboarding techniques taught, evaluated, and recommendations made for improvement. Students must provide their own transportation to Mont Ripley. It is recommended that students provide their own equipment. Daily rental and "rent for the season" equipment available at Mont Ripley. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Spring

PE 0222 - Alpine Ski Racing
Intermediate to advanced skills of alpine ski racing techniques taught. Ski races each week, alternating between giant slalom, slalom, and super G. Students must provide their own transportation to Mont Ripley. It is recommended that students provide their own equipment. Daily rental and "rent for the season" equipment available at Mont Ripley. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Spring

PE 0223 - Freestyle (jumps/tricks) Alpine Skiing
Fundamentals of freestyle (jumps/tricks) skiing techniques taught, evaluated, and recommendations made for improvement. Students must provide their own transportation to Mont Ripley. It is recommended that students provide their own equipment. Daily rental and "rent for the season" equipment available at Mont Ripley. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Spring

PE 0224 - Snowboard Racing (Bordercross)
Intermediate to advanced skills of bordercross snowboard racing techniques taught. Weekly bordercross racing. Students must provide their own transportation to Mont Ripley. It is recommended that students provide their own equipment. Daily rental and "rent for the season" equipment available at Mont Ripley. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Spring

PE 0225 - Freestyle (jumps/tricks) Snowboarding
Fundamentals of freestyle (jumps/tricks) snowboarding techniques taught, evaluated, and recommendations made for improvement. Students must provide their own transportation to Mont Ripley. It is recommended that students provide their own equipment. Daily rental and "rent for the season" equipment available at Mont Ripley. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Spring

PE 0226 - Intermediate Volleyball
Organization and development of team competition in volleyball. Requires previous volleyball experience. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring

PE 0227 - Intermediate Archery
Students will improve their fundamental knowledge and skills of archery leading to continued enjoyment and participation as a lifelong activity. Students must have their own bow. One dozen arrows must be supplied by the student (available for purchase on campus). May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: On Demand

PE 0230 - Water Polo
Fundamental skills, rules, strategy, and play of water polo. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring

PE 0232 - Intermediate Soccer
Intermediate to advanced techniques, skills, and strategies involved in soccer. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring, Summer

PE 0235 - Intermediate Cross Country Skiing
Development of touring, recreational, and racing skills in cross country skiing. Own equipment is recommended; rental equipment available. Basic skills evaluated to ensure proper level of skiing proficiency. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Spring

PE 0237 - Intermediate Table Tennis
Intermediate/advanced skills of table tennis will be taught. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring

PE 0238 - Intermediate Racquetball/Squash
Reviews the fundamentals and instructs the students on the intermediate/advanced skills of racquetball and squash. Gives all students the opportunity to play singles, cutthroat, and doubles. Racquets, balls, and eyeewear provided. Recommend use of personal racquet. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring

PE 0239 - Intermediate Badminton
Intermediate to advanced techniques, skills, and strategies involved in badminton. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring

PE 0240 - Intermediate Tennis
Intermediate to advanced techniques, skills, and strategies in tennis. Class meets at Gates Tennis Center. Non-marking court shoes must be worn. Tennis balls and racquets provided. Recommend use of personal racquet. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring

PE 0246 - Intermediate Billiards
Intermediate to advanced techniques, skills, and strategies in billiards. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring

PE 0252 - Social Dance II
Continuation of developing social dance skills, concepts of movement, style, and step patterns. Emphasis on practice in utilizing dance techniques.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring

PE 0253 - Aerobics II
Intermediate to advanced techniques and steps involved in aerobics. Requires previous aerobics experience. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring

PE 0255 - Intermediate Mountain Biking
Intermediate to advanced techniques and skills involved in mountain biking. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall

PE 0266 - Running for Fitness
The techniques, skills, and strategies involved in running. The class is physically strenuous. Requires appropriate running shoes and attire. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring
PE 0267 - Intermediate Yoga
Combined ancient Hatha yoga poses with modern fitness movement to create a total mind/body workout for all fitness levels. Improve breathing and oxygen intake.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring

PE 0268 - Intermediate Pilates
Students will learn advanced techniques to build strength and flexibility while engaging the muscles of their abdominals, lower back and hips, otherwise known as the "Power House" for a more streamline shape.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring

PE 0270 - TaekwonDo and Hapkido II
Continuation of kicking, blocking, punching, joint locking, and self-defense techniques of Taekwondo and Hapkido. Emphasizes improvement of skills and strategies involved in Taekwondo. No prerequisites required. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring

PE 0315 - Fitness Swimming
Practices the basic strokes, introduces knowledge in creating workouts to encourage swimming as a lifetime fitness activity. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Spring

PE 0320 - Advanced Skiing
Advanced skills of skiing techniques taught, evaluated, and recommendations made for improvement. Students must provide their own transportation to Mont Ripley. It is recommended that students provide their own equipment. Daily rental and "rent for the season" equipment available at Mont Ripley. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Spring

PE 0321 - Advanced Snowboarding
Advanced skills of snowboarding techniques taught, evaluated, and recommendations made for improvement. Students must provide their own transportation to Mont Ripley. It is recommended that students provide their own equipment. Daily rental and "rent for the season" equipment available at Mont Ripley. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Spring

PE 0330 - Club Sports
Club sport participation based on student interest. Group must be on the approved list of sports and all membership requirements must be up to date. Students enrolling in this course must participate in 14 hours of activity during the semester. Participation is tracked by instructor of record. No retroactive credit will be awarded for involvement in club sport activity.
Credits: 1.0; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring
Restrictions: Permission of instructor required

PE 0340 - Advanced Tennis
Advanced skills and strategy to make play more efficient. Multiple spins on forehand and backhand, ground strokes, drop shots, and different types of serves. Non-marking court shoes must be worn. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Spring
Pre-Requisite(s): PE 0240

PE 0355 - Advanced Road Biking
Learn advanced road biking techniques and strategies. Course requires own equipment, including road bike/wheels, bike shorts, biking shoes/pedals, and a helmet. Course also requires sufficient fitness to ride continuously in excess of 15 mph for 1.5 hours. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall

PE 0406 - Indoor Golf
Fundamentals skills of golf will be taught. May be used once as a general education co-curricular course.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring

PE 0420 - Ski Instructor Training
Students will learn how to teach ski classes. Upon completion of this course students will have the knowledge to complete the Level I certification test with the American Snowsports Education Association, if they choose.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: On Demand

PE 0421 - Snowboard Instructor Training
Students will learn to teach snowboard classes. Upon completion of this course students will have the knowledge to complete the Level I certification test with the American Snowsports Education Association, if they choose.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: On Demand

PE 0425 - Intramurals
Intramural activity that addresses varying and changing student interests. Sports vary. Students must be a member of iMelague.com/MTU. Students enrolling in the course must participate in 14 games/contests during the portion of the semester that the course is offered to receive a passing grade. Participation is tracked via iMelague.com/MTU. No retroactive credit will be awarded for involvement in intramural activities.
Credits: 0.5; Repeatable to a Max of 1; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman

PE 0430 - Club Sports Leadership
Leadership in club sport participation based on student interests. Students enrolling in this course must hold a position of leadership within the club sport. Group must be on approved list of sports and all membership requirements up to date. Students must participate in 14 hours of leadership activity during the semester. Participation is tracked by instructor of record. No retroactive credit will be awarded for involvement in club sport activity.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring
Restrictions: Permission of instructor required

PE 0435 - Rape Aggression Defense-Basic Physical Defense
The Rape Aggression Defense System is a program of realistic, self-defense tactics and techniques. The R.A.D. System is a comprehensive course for women that begins with awareness, prevention, risk reduction and avoidance, while progressing on to the basics of hands-on defense training. R.A.D. is not a martial arts program.
Credits: 1.0; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring
Co-Requisite(s): EH 2470

PE 1470 - Lifeguard Swimming
Water strokes and skills required for Lifeguard Training. Requires strong 500-yard continuous swim using front crawl, breaststroke, and sidestroke. Fulfills 1 unit of general education co-curricular activity.
Credits: 1.0; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Spring
Co-Requisite(s): EH 2470

PE 1580 - Water Safety Skills
American Red Cross swimming and diving skills required for certification in Water Safety Instructor. Fulfills 1 unit of general education co-curricular activity.
Credits: 1.0; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Spring
Co-Requisite(s): EH 2580

PE 1690 - Medical 1st Responder Training
Students will be trained on how to deal with medical emergencies. The physically active hands-on training includes a wide variety of medical skills and equipment such as airway control, backboards, spinal immobilization, oxygen therapy, patient assessment and splinting.
Credits: 1.0; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-3)
Semesters Offered: On Demand
Co-Requisite(s): EH 3690

PE 2010 - Varsity Football
Selective collegiate-level sports participation requiring an elite level of skill and extensive time commitment. May be used once as a general education co-curricular course.
Credits: 1.0; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-5)
Semesters Offered: Fall
Restrictions: Permission of department required
PE 2020 - Varsity Basketball
Selective collegiate-level sports participation requiring an elite level of skill and extensive time commitment. May be used once as a general education co-curricular course.
Credits: 1.0; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-5)
Semesters Offered: Fall, Spring
Restrictions: Permission of department required

PE 2028 - Ski Patrol (Hill)
National Ski Patrol training involving fitness, skiing proficiency, toboggan handling, and lift evacuation. Leads to qualifying membership test into National Ski Patrol. Requires payment of dues to become a member of National Ski Patrol. Offered first half of spring semester. Fulfills 1 unit of general education co-curricular activity.
Credits: 1.0; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-4)
Semesters Offered: Spring

PE 2030 - Varsity Hockey
Selective collegiate-level sports participation requiring an elite level of skill and extensive time commitment. May be used once as a general education co-curricular course.
Credits: 1.0; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-5)
Semesters Offered: Fall, Spring
Restrictions: Permission of department required

PE 2050 - Varsity Soccer
Selective collegiate-level sports participation requiring an elite level of skill and extensive time commitment. May be used once as a general education co-curricular course.
Credits: 1.0; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-5)
Semesters Offered: Fall, Spring
Restrictions: Permission of department required

PE 2080 - Varsity Track
Selective collegiate-level sports participation requiring an elite level of skill and extensive time commitment. May be used once as a general education co-curricular course.
Credits: 1.0; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-5)
Semesters Offered: Spring
Restrictions: Permission of department required

PH 1090 - The Physics Behind Music
Physics concepts and methods associated with musical instruments, musical recording, and musical acoustics are discussed at an introductory level. Topics include periodic motion, normal modes and resonance, superposition and Fourier series, waves, sound and acoustics, magnetism and electromagnetic induction, and topics from non-linear physics. Course is also offered online on demand in spring and summer semesters.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): MA 1031(C) or MA 1032(C)

PH 1091 - The Physics Behind Music Lab
A companion hands-on lab course covering topics from PH1090.
Credits: 1.0
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall
Pre-Requisite(s): PH 1090(C)

PH 1100 - Physics by Inquiry I
Experiments covering kinematics, force, conservation of momentum, conservation of energy, and waves are explored through guided construction. The course emphasizes understanding physical concepts through inquiry and the scientific method.
Credits: 1.0
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): MA 1160(C) or MA 1161(C)

PH 1110 - College Physics I
An overview of basic principles of kinematics, dynamics, elasticity, fluids, heat, thermodynamics, mechanical waves, and interference and diffraction of mechanical waves.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Summer
Restrictions: May not be enrolled in one of the following College(s): School of Technology, College of Engineering; May not be enrolled in one of the following Major(s): Physics, Applied Physics
Co-Requisite(s): PH 1111
Pre-Requisite(s): MA 1031 or MA 1032 or MA 1135(C) or MA 1160(C) or MA 1161(C)

PH 1111 - College Physics I Laboratory
Experiments covering kinematics, forces, conservation of momentum and energy, waves, and thermodynamics are explored through guided construction. The course provides inquiry-based laboratory experiences for concepts explored in PH1110.
Credits: 1.0
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Summer
Restrictions: May not be enrolled in one of the following College(s): School of Technology, College of Engineering; May not be enrolled in one of the following Major(s): Physics, Applied Physics
Co-Requisite(s): PH 1110

PH 1140 - Applied College Physics I
An algebra-based introduction to classical mechanics and its applications. Topics include kinematics, Newton's laws, impulse and momentum, work and energy, simple harmonic motion, mechanical waves and sound, and temperature and heat.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Major(s): Construction Management, Mechanical Engineering Tech, Electrical Eng Tech (BS), General Technology, Theatre & Entertain Tech (BS), Computer Network & System Admin
Co-Requisite(s): PH 1141
Pre-Requisite(s): MA 1031 or MA 1032 or MA 1160(C) or MA 1161(C) and (PH 1100 or PH 1111 or PH 1141(C) or PH 1161)

PH 1141 - Applied College Physics I Laboratory
Experiments covering kinematics, forces, conservation of momentum and energy, waves, and thermodynamics are explored through guided construction. The course provides inquiry-based laboratory experiences for concepts explored in PH1140.
Credits: 1.0
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Major(s): Engineering Technology, Mechanical Engineering Tech, Computer Network & System Admin, Electrical Eng Tech (BS), Theatre & Entertain Tech (BS), Construction Management
Co-Requisite(s): PH 1140
PH 1160 - Honors Physics I - Mechanics
Calculus-based introduction to classical mechanics. Topics include mathematical concepts, kinematics, Newton's laws, the gravitational force, work and energy, and collisions. Also introduces departmental facilities, research within the department, and professional opportunities in physics. Intended for physics majors; highly motivated students seeking an invigorating introduction to physics may enroll with permission of the instructor.
Credits: 4.0
Lec-Rec-Lab: (4-0-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Major(s): Physics, Physics, Applied Physics
Co-Requisite(s): PH 1161
Pre-Requisite(s): MA 1160(C) or MA 1161(C)

PH 1161 - Introduction to Experimental Physics I
A laboratory complement to PH1160. Experiments covering kinematics, force, conservation of momentum, conservation of energy, waves and thermodynamics are explored through guided construction. The course emphasizes understanding physical concepts through inquiry and the scientific method.
Credits: 1.0
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Major(s): Physics, Physics, Applied Physics
Co-Requisite(s): PH 1160

PH 1200 - Physics by Inquiry II
Experiments covering Coulomb's law, electric and magnetic fields, circuits, induction, and geometric optics are explored through guided construction. The course emphasizes understanding physical concepts through inquiry and the scientific method.
Credits: 1.0
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): PH 1100 or PH 1111 or PH 1141 or PH 1161

PH 1210 - College Physics II
An overview of basic principles of static and dynamic electricity and magnetism, electromagnetic waves, reflection and refraction of light, interference and diffraction of light, special theory of relativity, wave theory of matter, particle theory of electromagnetic waves, theory of the atom, the nucleus, and elementary particles.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: May not be enrolled in one of the following College(s): School of Technology, College of Engineering; May not be enrolled in one of the following Major(s): Physics, Applied Physics
Pre-Requisite(s): PH 1200(C) and (PH 1110 or PH 1100)

PH 1240 - Applied College Physics II
An overview of static and dynamic electricity and magnetism, electromagnetic waves, basic optics, and an introduction to modern and nuclear physics with an emphasis on problem solving and applications.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following College(s): School of Technology
Co-Requisite(s): PH 1200
Pre-Requisite(s): PH 1140 or PH 1110

PH 1360 - Honors Physics II - Rotation and Vibration
Continuation of PH 1160. Topics include rotational motion, simple harmonic motion and mechanical waves. Offered first half of spring semester.
Credits: 2.0
Lec-Rec-Lab: (4-0-0)
Semesters Offered: Spring
Co-Requisite(s): PH 1361
Pre-Requisite(s): (PH 1160 or PH 2100) and MA 2160(C)

PH 1361 - Introductory Experimental Physics II
Laboratory complement to PH 1360. Waves and thermodynamics are explored through guided construction. The course emphasizes understanding physical concepts through inquiry and the scientific method.
Credits: 1.0
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Spring
Co-Requisite(s): PH 1360

PH 1500 - Extraordinary Concepts in Physics
Extraordinary concepts will be surveyed. Included will be time dilation and length contraction in Special Relativity, physics of Time Travel, curvature in General Relativity, interpretations of Uncertainty Principle, counter-intuitive examples of Two-Slit Experiment, Schrodinger's Cat, Maxwell's Demon, Bell's Inequality, curvature in cosmology, dark matter, dark energy, black hole evaporation, string theory, and gravitational lensing.
Credits: 2.0
Lec-Rec-Lab: (2-0-0)
Semesters Offered: On Demand

PH 1600 - Introductory Astronomy
Introduces fundamentals of astronomy. Topics include Kepler's and Newton's laws of motion, origin and evolution of the solar system, galactic astronomy, extra-galactic astronomy, cosmology, and modern instrumentation, including space-based astronomy.
Credits: 2.0
Lec-Rec-Lab: (2-0-0)
Semesters Offered: Fall, Spring, Summer

PH 1610 - Introductory Astronomy Lab
Demonstrates fundamentals of astronomy using non-telescopic and telescopic observations, and computer simulations. Topics include angular size measurements, season-dependent measurements, phases of the moon, phases and orbits of planets, brightness of stars, introduction to the use of MTU's Observatory, instrumentation, and applications of computer programs involving cosmology.
Credits: 1.0
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Summer
Co-Requisite(s): PH 1600

PH 2020 - Introduction to Error Analysis and Scientific Programming
An introduction to error analysis and scientific programming. Students will develop the skills needed to reduce and analyze data acquired in upper level physics labs (e.g. PH3480). Examples include error propagation and computer aided curve fitting.
Credits: 1.0
Lec-Rec-Lab: (1-0-0)
Semesters Offered: Fall
Pre-Requisite(s): PH 1160 or PH 2100

PH 2100 - University Physics I - Mechanics
A calculus-based introduction to classical mechanics. Topics include kinematics, Newton's laws, impulse and momentum, work and energy, and the universal law of gravitation.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): PH 1100(C) and (MA 1160 or MA 1161 or MA 1135 or MA 2160(C))

PH 2200 - University Physics II - Electricity and Magnetism
A calculus-based introduction to electromagnetism. Topics include Coulomb's law, electric fields, Gauss's law, electric potential, capacitance, circuits, magnetic forces and fields, Ampere's law, induction, Maxwell's equations, and electromagnetic waves.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): (PH 1200(C) or PH 2261(C)) and (PH 2100 or PH 1160) and MA 2160

PH 2230 - Electronics for Scientists
An introduction to analog and digital electronics with an emphasis on their use in the laboratory. Topics include linear devices and basic linear circuit analysis; diodes, transistors, op-amps; the use of digital components, including logic gates, flip-flops, counters, clocks and microcontrollers, and analog to digital conversions.
Credits: 4.0
Lec-Rec-Lab: (3-0-3)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Major(s): Electrical Engineering, Computer Engineering
Pre-Requisite(s): PH 2200 or PH 2260

PH 2260 - Honors Physics III - Electricity and Magnetism
Calculus-based introduction to electromagnetism. Topics include Coulomb's law, electric fields, Gauss's law, electric potential, capacitance, circuits, magnetic forces and fields, Ampere's law, induction, Maxwell's equations, electromagnetic waves and geometrical optics.
Credits: 4.0
Lec-Rec-Lab: (4-0-0)
Semesters Offered: Fall
Pre-Requisite(s): (PH 1160 or PH 2100) and (PH 1200(C) or PH 2261(C)) and MA 2160

PH 2261 - Introduction to Experimental Physics III
A laboratory complement to PH2260. Experiments covering Coulomb's law, electric and magnetic fields, circuits, induction, geometric optics, and modern physics are explored through guided construction. The course emphasizes understanding physical concepts through inquiry and the scientific method.
Credits: 1.0
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall
Co-Requisite(s): PH 2260
Pre-Requisite(s): PH 1100 or PH 1161
PH 2300 - University Physics III-Fluids and Thermodynamics
A calculus-based introduction to fluids and thermal physics. Topics include fluid motion, propagation of heat and sound, temperature and the kinetic theory of gases, heat capacity and latent heat, first law of thermodynamics, heat engines and the second law, entropy, and an introduction to statistical mechanics. Offered second half of spring semester.
Credits: 3.0
Lec-Rec-Lab: (4-0-0)
Semesters Offered: Spring
Pre-Requisite(s): PH 1160 or PH 2100

PH 2400 - University Physics IV-Waves and Modern Physics
A calculus-based introduction to waves and modern physics. Topics include interference and diffraction, special relativity, photons and matter waves, the Bohr atom, wave mechanics, atomic physics, molecular and solid-state physics, and nuclear physics.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): PH 2200 or PH 2260

PH 3110 - Theoretical Mechanics I
An intermediate study of mechanics, including the study of Newtonian mechanics of a single particle and multiple-particle systems, oscillations, motion in noninertial reference frames, gravitation and central-force motion, and Lagrangian mechanics.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Pre-Requisite(s): (PH 2200 or PH 2260) and (MA 3520 or MA 3521 or MA 3530 or MA 3560)

PH 3111 - Theoretical Mechanics II
A continuation of PH3110. Includes the study of the rigid body motion, relativistic mechanics, and coupled oscillations. Additional topics may include chaos theory, Hamiltonian mechanics, and continuous systems.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Pre-Requisite(s): PH 3110

PH 3210 - Optics
An introduction to geometrical and physical optics. Topics in geometrical optics include ray analysis of mirrors, lenses, prisms, and optical systems. Topics in physical optics include polarization, interference, interferometry, and diffraction. The laboratory explores optics through experiments in imaging, fiber optics, interferometry, diffraction, polarization, and laser beam propagation.
Credits: 3.0
Lec-Rec-Lab: (2-0-3)
Semesters Offered: Fall
Pre-Requisite(s): PH 2400 and (MA 3520 or MA 3521 or MA 3530 or MA 3560)

PH 3300 - Thermodynamics and Statistical Mechanics
Thermodynamic systems, heat, work, laws of thermodynamics, formal mathematical relations, cycles, phase equilibrium, and multicomponent systems. Elementary kinetic theory. Introduction to microscopic view of entropy, ensemble theory, and applications of statistical mechanics.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Pre-Requisite(s): PH 2300 or PH 1360

PH 3310 - Quantum Physics I
An introduction to the foundations of modern physics and Schrodinger's wave mechanics. Topics include thermal radiation, particle-like properties of radiation, Bohr's model of the atom, matter waves, Schrodinger's wave mechanics, quantization of angular momentum, and the one-electron atom.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Pre-Requisite(s): PH 2400 and (MA 3520 or MA 3521 or MA 3530 or MA 3560)

PH 3410 - Quantum Physics II
A continuation of PH3410. Includes the study of spin and magnetic interactions, multi-electron atoms, quantum statistics, molecules, solids, and elementary particles.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Pre-Requisite(s): PH 3410

PH 3480 - Advanced Physics Laboratory
Through a series of experiments, students investigate physical phenomena that underlie modern physics. In the process, students become familiar with experimental techniques and instrumentation used in modern research laboratories.
Credits: 2.0
Lec-Rec-Lab: (0-0-6)
Semesters Offered: Spring
Pre-Requisite(s): PH 2230 and PH 3210

PH 4010 - Senior Physics Colloquium I
Class discussion of the literature in the field of physics. Requires oral and written presentations.
Credits: 1.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior
Co-Requisite(s): PH 4080

PH 4011 - Senior Physics Colloquium II
A continuation of PH4011. Class discussion of current literature and recent advances in physics. Requires oral and written presentations.
Credits: 1.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior
Co-Requisite(s): PH 4081
Pre-Requisite(s): PH 4010

PH 4050 - Qualitative Methods in Physics
General methods and approaches of the physicist, including modeling, scaling, numerical estimation, and dimensional analysis as applied to the development, understanding, and solution of physics problems. Serves as an excellent preparation for students taking the GRE Subject Test in physics.
Credits: 1.0; Graded Pass/Fail Only
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Major(s): Physics, Applied Physics; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

PH 4080 - Senior Research I
Introduction to research under the guidance of a faculty member. In addition, creative problem solving will be assessed via a student-initiated project.
Credits: 3.0
Lec-Rec-Lab: (0-0-6)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior
Co-Requisite(s): PH 4010
Pre-Requisite(s): PH 3480

PH 4081 - Senior Research II
Continuation of research under the guidance of a faculty member, culminating in a written report and presentation of results at an undergraduate research forum.
Credits: 3.0
Lec-Rec-Lab: (0-0-6)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior
Co-Requisite(s): PH 4011
Pre-Requisite(s): PH 4080

PH 4090 - Senior Thesis
Students prepare an in-depth written thesis on an approved topic in physics. Normally taken the last semester before graduation in conjunction with PH4081.
Credits: 1.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Spring
Restrictions: Permission of instructor required; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior
PH 4210 - Electricity and Magnetism I
Intermediate study of the basic theory of electricity and magnetism, including a detailed study of electrostatic field theory and an introduction to magnetostatics.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Pre-Requisite(s): (PH 2200 or PH 2260) and PH 3110 and (MA 3520 or MA 3521 or MA 3530 or MA 3560)

PH 4211 - Electricity and Magnetism II
A continuation of PH4210. Intermediate study of magnetostatics, electrodynamics, and electromagnetic waves.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Pre-Requisite(s): PH 4210
Semesters Offered: Spring

PH 4390 - Computational Methods in Physics
An overview of numerical and computer methods to analyze and visualize physics problems in mechanics, electromagnetism, and quantum mechanics. Utility and potential pitfalls of these methods, basic concepts of programming, UNIX computing environment, system libraries and computer graphics are included.
Credits: 3.0
Lec-Rec-Lab: (2-0-3)
Pre-Requisite(s): PH 2020 and PH 3410
Semesters Offered: Fall, Spring

PH 4395 - Computer Simulation in Physics
Role of computer simulation in physics with emphasis on methodologies, data and error analysis, approximations, and potential pitfalls. Methodologies may include Monte Carlo simulation, molecular dynamics, and first-principles calculations for materials, astrophysics simulation, and biophysics simulations.
Credits: 3.0
Lec-Rec-Lab: (2-0-3)
Pre-Requisite(s): (PH 2300 or PH 1360) and (CH 1150 and CH 1151) and (MA 3520 or MA 3521 or MA 3530 or MA 3560)

PH 4610 - Stellar Astrophysics
Topics include the composition and dynamics of our galaxy, dynamics of stellar encounters, spiral density wave theory, clusters of galaxies, theoretical cosmology, physics of the early universe, and observational cosmology. Course offered every third year beginning 2007-08.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Pre-Requisite(s): PH 1600 and PH 2400 and (MA 3520 or MA 3521 or MA 3530 or MA 3560)

PH 4640 - Fundamentals of Atmospheric Science
Fundamental principles of atmospheric science including thermodynamics, aerosol and cloud physics, radiative transfer, and atmospheric dynamics.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Pre-Requisite(s): (PH 2200 or PH 2260) and (PH 1360 or PH 2300) and MA 3160 and (MA 3520 or MA 3521 or MA 3530 or MA 3560)

PH 4710 - Methods of Teaching Physics
Hands-on exploration of physics education methods in classroom, laboratory, and tutoring environments. Students study highlights of physics education research and explore use of several tools and pedagogical techniques, including web-based homework systems, simulations, classroom feedback systems, and equipment for laboratories and lecture demonstrations.
Credits: 2.0
Semesters Offered: Spring - Offered alternate years beginning with the 2010-2011 academic year

PSY 2000 - Introduction to Psychology
Introduction to the scientific study of psychological structures and processes involved in individual and group behavior. Explores theoretical accounts of the foundations of human behavior and examines empirical support. Topics may include personality, disorders, therapy, development, and social psychology, perception, learning, cognition, emotion, and states of consciousness.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Pre-Requisite(s): PSY 2000

PSY 2100 - Counseling Psychology
Major approaches used in contemporary counseling psychology, the current status of the profession, and ethical issues encountered will be examined to provide students with a broad understanding of the field. This course does not train students to be counselors.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Pre-Requisite(s): PSY 2000

PSY 2200 - Behavior Modification
An introduction to techniques of behavior modification through the application of learning theories such as classical and operant conditioning. Students will conduct a case study project designed to modify a personal behavior.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)

PSY 2300 - Developmental Psychology
A survey of human development across the life span (prenatal, infant, child, adolescent, and adult) in the areas of biological, cognitive, social, emotional, and personality development. Provides insight into both the universality of human development and the uniqueness of individuals.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Pre-Requisite(s): PSY 2000

PSY 2400 - Health Psychology
Examines the theoretical, empirical, and historical bases for health psychology. Topics may include the effects of stress, determinants of addictive behavior, the impact of psychological factors on physical health, obesity, and the causes and treatment of chronic pain.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Pre-Requisite(s): PSY 2000
PSY 2501 - Intro to the Psychology Major
Psychology majors examine the field of psychology and major degree requirements resulting in an undergraduate plan of study focused on graduate school admission or career preparation. Students will be introduced to department research and other opportunities.

Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Major(s): Psychology
Pre-Requisite(s): PSY 2000(C)

PSY 2600 - Psychology of Death and Dying
An examination of theory, research, and issues in the psychology of death and dying. Topics may include the development of death concepts, death anxiety in society, the needs of the dying person, the psychology of grieving, and unexpected losses.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring - Offered alternate years beginning with the 2013-2014 academic year
Pre-Requisite(s): PSY 2000

PSY 2720 - Statistics for the Behavioral Sciences
An understanding of statistical concepts and ability to conduct statistical analyses (using both hand calculation and SPSS) as used in Social and Behavioral Sciences research. Topics include descriptive statistics, correlation, and inferential statistics through ANOVA.

Credits: 4.0
Lec-Rec-Lab: (0-3-3)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Major(s): Social Sciences, Psychology
Pre-Requisite(s): MA 1031 or MA 1032 or MA 1160(C) or MA 1161(C)

PSY 2800 - Critical Thinking for Social and Behavioral Sciences
This course will help develop critical thinking skills central to the social and behavioral sciences. Topics may include arguments, logic, evaluating causal claims, evaluating surveys, theory evaluation, experiment evaluation, writing in psychology, and ethical considerations in the social and behavioral sciences.

Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Pre-Requisite(s): PSY 2000(C)

PSY 3000 - Research Methods & Stats
Introduction to experimental design, general research methodology, computer analysis and interpretation of data. Emphasizes issues and methods involved in psychological research. Topics include experimental design and validity, choosing appropriate data analysis techniques, statistical analysis, and APA writing style.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Summer
Restrictions: Must be enrolled in one of the following Major(s): Psychology; May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): PSY 2000 and (MA 2720 or PSY 2720)

PSY 3001 - Experimental Methods and Statistics II
Second course in psychological research methodology and statistics, both experimental and non-experimental. Students design, execute, interpret, and report psychological research.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring, Summer
Restrictions: Must be enrolled in one of the following Major(s): Psychology; May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): PSY 2000 and PSY 3000

PSY 3010 - Theories of Personality
Introduction to the variety of approaches to personality that underlie many clinical models. Discusses the formulation of personality theory, its purpose, and problems associated with personality theory generation. Emphasizes classical and contemporary theories of personality, their various applications to human behavior, and a review of relevant research findings.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring, Summer
Pre-Requisite(s): PSY 2000 and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

PSY 3020 - Moral Psychology
This course focuses on moral behavior and reasoning informed by empirical science and philosophy. Topics may include moral motivation, moral responsibility, character traits, virtues, cross-cultural differences, reactive attitudes, moral development, and applied issues.

Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2014-2015 academic year
Pre-Requisite(s): PSY 2000 and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

PSY 3030 - Abnormal Psychology
Helps the student build an understanding of abnormal behavior through critical examination of historical and contemporary models used in this field. The student learns the causes and treatment proposed by Cognitive-Behavioral, Psychodynamic and Sociocultural Models with particular emphasis placed on the Diagnostic and Statistical manual used by clinicians for diagnoses.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Summer
Pre-Requisite(s): PSY 2000 and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

PSY 3040 - History and Systems of Psychology
Traces major historical contributions to current psychology from ancient to modern times. Examines significant ideas and discoveries from philosophy, mathematics, and the natural and medical sciences as they relate to the development of psychology. Discusses philosophical, theoretical, and methodological controversies that surfaced as part of these historical developments.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): PSY 2000

PSY 3060 - Physiological Psychology
Study of the relations between psychological manipulations and resulting physiological responses to promote understanding of mind/body interaction. Will examine psychophysiological measurement methods, research, and the application of psychophysiology.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): PSY 2000 and (BL 1020 or BL 1040 or BL 2010)

PSY 3070 - Cross-Cultural Psychology
Introduces the student to cross cultural psychology and sociocultural theory as it is applied to psychology. Examines research on cultural specific and universal behaviors. Emphasizes the benefits and challenges of diversity in organizations and diversity skills that promote interpersonal and organizational success.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2012-2013 academic year
Pre-Requisite(s): PSY 2000

PSY 3090 - Directed Research: Undergraduate Research Assistant in Psychology
Directed research in the field of Psychology through the application of research techniques.

Credits: variable to 3.0; May be repeated
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required; Must be enrolled in one of the following Major(s): Psychology; May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): PSY 2000

PSY 3095 - Teaching Assistant
Undergraduate Teaching Assistant for Principles of Psychology or other Psychology course, including tutoring, assessment, test construction.

Credits: variable to 3.0; May be repeated
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required; Must be enrolled in one of the following Major(s): Psychology
Pre-Requisite(s): PSY 2000

PSY 3100 - Application of Treatment Models
An applied review of psychological treatment models, including their history, their strengths and weaknesses, and the fundamental concepts that support each model. Students will be required to apply one of the models in a direct practice format.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): PSY 2000 and PSY 2100

PSY 3200 - Motivation and Emotion
Introduction to the theoretical, physiological, cognitive, and behavioral factors underlying the processes of motivated behaviors and emotional states. Emphasis is placed on methods for studying motivation and emotion and their role in human behavior.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): PSY 2000
PSY 3250 - Persuasion and Attitude Change
Human beings develop attitudes as a result of experience. Attitudes shape future behavior and impact perception. This course will explore how attitudes are identified, categorized and measured, and will examine many of the variables associated with changing established attitudes.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: On Demand
Pre-Requisite(s): PSY 2000

PSY 3300 - Psychology of Deviance
This course will guide the student through a scholarly study from how deviance is defined to an in-depth analysis of the numerous theories that seek to explain why individuals commit deviant acts.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2015-2016 academic year
Pre-Requisite(s): PSY 2000

PSY 3700 - Industrial Organizational Psychology
The psychology of work and organizations. Introduction to the use and application of psychology in the workplace. Focus is on the development of employees and organizational structure, and social behavior including the management of work groups and organizations.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2012-2013 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): PSY 2000

PSY 3720 - Social Psychology
Survey of social, cultural, and cognitive influences on individual and group behavior. Introduces attitude formation, social conformity, personal perception, aggression, cooperation, and interpersonal and intergroup relations.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring, Summer
Pre-Requisite(s): PSY 2000 and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

PSY 3750 - Judgment and Decision Making
How can we make better decisions? Using examples from medicine, politics, law, business, and daily life, we review "descriptive" (psychological), "normative" (rational), and "prescriptive" (decision-engineering) theory. Topics include judgment, cognition, emotion, risk, uncertainty, optimization, heuristics, biases, morality, and applications.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): PSY 2720 or MA 2720

PSY 3850 - Human Factors Psychology
Basic psychological concepts critical to the design of human-technological systems. This class provides an applied perspective of psychological research and insight into the most unpredictable and error-prone component of human-machine systems - the human! Appropriate for both psychology and engineering students.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): PSY 2720

PSY 3860 - Human Performance
An overview of cognitive task analysis and process tracing methods used to examine human performance in complex socio-technical systems. Topics include knowledge elicitation, concept mapping, critical decision method, and protocol analysis.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): PSY 2000

PSY 3870 - Human-Centered Design
This course will focus on the human-system (computers, appliances, mobile devices, etc.) Interaction regarding the design and development of products. Students will experience hands-on HCI activities (analysis-design-evaluation) and practice research methods based on HCI theory and perspectives.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Freshman

PSY 4010 - Cognitive Psychology
A systematic survey of classical and contemporary research topics in human information processing and learning. Topics include models of cognition, perception/pattern recognition, attention, the nature of mental representation and processing; the architecture of memory, imagery, concepts, and prototypes; reasoning, decision making, problem solving, and cognitive development.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Summer
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): PSY 2000

PSY 4060 - Cognitive Neuroscience
Topics in the field of cognitive neuroscience, examining the neural basis of cognition. Topics may include perception, attention, memory and language.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): PSY 3060

PSY 4080 - Topics in Psychology
An examination of a specific area or approach within the field of Psychology.
Credits: variable to 4.0; May be repeated
Semesters Offered: On Demand
Pre-Requisite(s): PSY 2000

PSY 4090 - Independent Study in Psychology
Designed to allow students to participate in independent readings or research in a variety of areas within psychology.
Credits: variable to 6.0; Repeatable to a Max of 9
Semesters Offered: On Demand
Restrictions: Permission of instructor required; Must be enrolled in one of the following Major(s): Psychology; May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): PSY 2000

PSY 4095 - Field Experience in Psychology
Firsthand experience with the application of psychological principles in the field through volunteer placement with a community agency or business. Students are responsible for obtaining field placement site in coordination with instructor. Students complete a comprehensive paper.
Credits: variable to 3.0; Repeatable to a Max of 6; Graded Pass/Fail Only
Semesters Offered: Fall, Spring
Restrictions: Permission of instructor required; Must be enrolled in one of the following Major(s): Psychology; May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): PSY 2000

PSY 4110 - Learning and Memory
Theories of learning and memory from traditional animal research findings, human research, and more recent trends examining the neural basis of learning and memory will be examined to understand changes in behavior, including the acquisition and retention of knowledge.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): PSY 2720

PSY 4160 - Sensation and Perception
Examination of basic sensory mechanisms and perceptual phenomena. Sensory mechanisms reviewed will include vision, audition, olfaction, gustation, vestibular system and touch.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): BL 1040 or BL 1020 and PSY 3000

PSY 4220 - Psychology and Law
Application of psychological principles to legal concerns and the interaction of psychology and law. Topics include perception, memory, and decision-making processes as applied to eyewitnesses, identification and evaluation of suspects, jury trials, capital punishment, and other current topics.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): PSY 2000

PSY 4400 - Tests and Measurements
Review of psychological tests and test theory, along with principles of construction and analysis of psychological tests.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Major(s): Psychology; May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): PSY 2720 or MA 2720
PSY 4500 - Senior Seminar: Psychology Capstone
Focusing on application to graduate programs, an intensive exploration into an area (e.g., experimental, developmental, clinical) of psychology or related field, will enhance learning and synthesize career goals in an effort to transition to an advanced educational program.
Credits: 1.0; Graded Pass/Fail Only
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Major(s): Psychology;
May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior
Pre-Requisite(s): PSY 3000(C)

Sciences and Arts
SA 1000 - Exploring Majors at Michigan Tech
Exploration of majors and related career opportunities. Includes an introduction to University resources such as the Career Center, presentations by students in various majors, an examination of individual interests and abilities, opportunities for discussion and reflection, and guidance in choice of appropriate courses.
Credits: 1.0
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring

Systems Administration Technology
SAT 1200 - Introduction to Programming
Introductory course in C/C++ programming. Topics include top-down analysis of problems, structured programming, control statements, loops, and functions, arrays, and pointers. Basic concepts of object-oriented programming (classes, objects, function overloading) will also be introduced.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Major(s): Industrial Technology, Computer Network & System Admin; Must be enrolled in one of the following Class(es): Freshman, Sophomore
SAT 1610 - Computer and Operating Systems Architecture
Fundamentals of computer organization, operating system architecture, PC/WS major subassemblies, PC and server configuration planning, power interfaces, system assembly/set-up, connection of peripherals, installing fundamental operating system software, system testing/debugging and planning and installation of application software portfolios.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Spring
Pre-Requisite(s): SAT 1200 or CS 1111
SAT 1700 - Cyber Ethics
Ethics, morality, and privacy issues when working with technology. Topics include: foundational and professional issues in cyber ethics; privacy, security, and crime in cyberspace; intellectual property and internet regulation; the digital divide and online communities; and emerging and converging technologies.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Major(s): Computer Network & System Admin
SAT 2343 - Network Administration I
Introduction to basic networking concepts and implementation. Topics include OSI model, subnetting, network addressing, data encapsulation, network topologies, and basic configuration of networking hardware including cabling, bridges, routers, and other communications.
Credits: 4.0
Lec-Rec-Lab: (0-3-2)
Semesters Offered: Fall, Summer
Pre-Requisite(s): SAT 1610
SAT 2511 - Microsoft System Administration
Microsoft server installation and configuration in an enterprise environment. Topics include: planning for server deployment and management; monitoring and maintaining servers; planning application and data provisioning; and planning for business continuity and high availability.
Credits: 4.0
Lec-Rec-Lab: (0-3-2)
Semesters Offered: Spring, Summer
Pre-Requisite(s): SAT 2343
SAT 2711 - Linux System Administration
Linux system installation and configuration in an enterprise environment. Topics include: Linux system architecture; Linux installation and package management; GNU and UNIX Commands; Linux file systems; hierarchy standards; shells, scripting and data management; user interfaces and desktops; administrative tasks; essential system services; and networking fundamentals and security.
Credits: 4.0
Lec-Rec-Lab: (0-3-3)
Semesters Offered: Fall, Summer
Pre-Requisite(s): SAT 1200 or CS 1111
SAT 3002 - Application Programming Introduction
Students will develop problem solving skills through the application of a commonly used high-level programming language. Topics include: nature of the programming environment; fundamentals of programming languages; structured programming concepts; object-oriented programming concepts; desirable programming practices and design; and debugging and testing techniques.
Credits: 3.0
Lec-Rec-Lab: (0-2-1)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): CS 1111 or CS 1121
SAT 3200 - Storage Area Networking
Study of distributed network storage methods that include ISCSI, DAS, NAS, and SAN technologies. Other topics include configuration management, storage farms, backup, and recovery.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Fall, Spring
Pre-Requisite(s): SAT 2511 and SAT 2711
SAT 3210 - Database Management
Introductory course on database management. Topics include data modeling, database design, implementation techniques, Oracle SQL Language, database administration and security.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Fall, Summer
Restrictions: Must be enrolled in one of the following Major(s): Computer Network & System Admin
Pre-Requisite(s): SAT 2511 and SAT 2711
SAT 3343 - Network Administration II
Study of network devices in various architectures. Topics include routing protocols, TCP/IP, access-lists, remote network structures, network topologies, telnet and SSH authentication, switch programming, VLAN and STP configuration, IP traffic control, network troubleshooting and WAN encapsulation.
Credits: 4.0
Lec-Rec-Lab: (0-3-2)
Semesters Offered: Spring
Pre-Requisite(s): SAT 2343 or CS 3411
SAT 3611 - Infrastructure Service Administration
Administering Linux and Microsoft servers together to provide infrastructure services to mixed clients. Topics include: DNS; DHCP; authentication, file, web, mail, and print servers; firewalls; and best practices for combining and mixing server platforms in an enterprise environment.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Fall
Pre-Requisite(s): SAT 2511 and SAT 2711
SAT 3812 - Cyber Security I
The evolution of information security into cybersecurity and its relationship to nations, organizations, society, and individuals. Exposure to multiple cybersecurity technologies, processes, and procedures; analyzing threats, vulnerabilities and risks present; and developing appropriate strategies to mitigate potential cybersecurity issues. Applied lab to develop cyber security offensive attributes and learn how to prevent and/or mitigate threats.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Fall
Pre-Requisite(s): SAT 2711
SAT 3820 - Wireless System Administration
Study of wireless communications, standards, and regulations in an enterprise environment. Topics include: various radio frequency and light communications; IEEE 802.11 Regulations and Standards; protocols and devices; network implementation; network security; and site surveying.
Credits: 4.0
Lec-Rec-Lab: (0-3-2)
Semesters Offered: Spring, Summer
Restrictions: Must be enrolled in one of the following Major(s): Computer Network & System Admin
Pre-Requisite(s): SAT 3812
SAT 3900 - New Technologies Seminar
Offered first half of semester, to be taken concurrently with SAT3901. Weekly seminar series in which speakers from industry, universities, and government discuss current developments in networking and computer technology. The emphasis is on open research topics and questions that may lead to collaborative work with faculty and graduate students.
Credits: 1.0; Repeatable to a Max of 6; Graded Pass/Fail Only
Lec-Rec-Lab: (0-2-0)
Semesters Offered: Fall
Pre-Requisite(s): SAT 3901

SAT 3901 - Becoming Human - Communication and Technical Improv Seminar
Offered second half of semester, to be taken concurrently with SAT3900. Weekly seminar series aimed at developing leadership qualities, soft skills, public speaking, and reactiveory skills for students in technical fields. A fun and safe environment to develop and improve communication skills through situation and scenario-based exercises that include team building and games.
Credits: 1.0; Graded Pass/Fail Only
Lec-Rec-Lab: (0-2-0)
Semesters Offered: Fall
Pre-Requisite(s): SAT 3900

SAT 4240 - Voice over IP Engineering
Voice over IP (VoIP) engineering and design. Topics include call and session protocols such as SIP, H.323, IAX and MGCP; VAD and PLC; common practical issues such as call redirection; codec integration and quality of service measurements.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Spring - Offered alternate years beginning with the 2011-2012 academic year
Restrictions: Must be enrolled in one of the following Major(s): Computer Network & System Admn
Pre-Requisite(s): SAT 2511 and SAT 2711 and SAT 3343

SAT 4310 - Advanced Scripting Programming
Emphasizes advanced portions of scripting programming, testing, implementation and documentation (i.e. PERL, PHP, Python and Shell Scripting). Other topics include language syntax data and file structures, input/output devices, file and graphical user interfaces.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Major(s): Computer Network & System Admn
Pre-Requisite(s): (SAT 1200 or CS 1111) and SAT 2511 and SAT 2711

SAT 4343 - Network Engineering
Topics include router and switch flow control; VoIP, compression and load balancing; VPN networks involving MPLS, IPSEC and PPP; advanced access-list configuration; AAA; Kerberos; TACACS, firewalls, and configuration of advanced routing protocols.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Spring - Offered alternate years beginning with the 2010-2011 academic year
Pre-Requisite(s): SAT 3343

SAT 4411 - Data Center Engineering
Data center and virtualization strategies and design for an enterprise environment. Topics include: data center planning; disaster recovery; virtualization methods; and cloud computing services to provide business continuity.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Spring
Pre-Requisite(s): SAT 3200 and SAT 3611

SAT 4480 - Senior Project I
Capstone course requiring the application of knowledge gained in lower division courses. Projects are team oriented, require weekly progress reports, and culminate with a final report and oral presentation.
Credits: 3.0
Lec-Rec-Lab: (0-0-6)
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required; Must be enrolled in one of the following Major(s): Computer Network & System Admn
Pre-Requisite(s): (SAT 3210 and (SAT 3611 or (SAT 3511 and SAT 3711))

SAT 4600 - Web Application Development
An introduction to the building and administration of web applications. Topics covered include: Apache web server development; Tomcat application server; HTML; cascading style sheets; JavaScript; JQuery; server side includes; server side application development; web services; SSL/TLS; and authentication/authorization.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Spring
Pre-Requisite(s): SAT 3210 and (SAT 3611 or (SAT 3511 and SAT 3711))

SAT 4812 - Cyber Security II
An advanced course in cyber security that covers information assurance, cryptography and data security, and malware analysis. Key topics include: buffer overflow; security audits; cryptographic systems (symmetric and public-key algorithms); public-key certificates (X.509); message authentication; Kerberos; authentication applications; electronic mail security; IP security; and SELinux.
Credits: 3.0
Lec-Rec-Lab: (0-0-6)
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required; Must be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): SAT 4480

SAT 4996 - Special Topics in Computer Network Systems Administration
Selected additional topics of interest in Computer Network Systems Administration based on student and faculty demand and interest. May be a tutorial, seminar, workshop, project, or class study.
Credits: variable to 3.0; Repeatable to a Max of 6
Semesters Offered: On Demand
Restrictions: Permission of instructor required; Must be enrolled in one of the following Major(s): Computer Network & System Admn; Must be enrolled in one of the following Class(es): Senior
Pre-Requisite(s): (On Demand)

SAT 4997 - Independent Study in Computer Network Systems Administration
Independent study of an approved topic under the guidance of a Computer Network Systems Administration faculty member. May be either an academic, design, or research problem/project.
Credits: variable to 3.0; Repeatable to a Max of 6
Semesters Offered: On Demand
Restrictions: Permission of instructor required; Must be enrolled in one of the following Major(s): Computer Network & System Admn; Must be enrolled in one of the following Class(es): Senior
Pre-Requisite(s): (On Demand)

SAT 4998 - Undergraduate Research in Computer Network Systems Administration
An undergraduate research experience in Computer Network Systems Administration. Under the guidance of a CNSA faculty member, students work on a selected/approved research problem or work directly on faculty on active research projects/grants. May require more than one semester to complete.
Credits: variable to 6.0; Repeatable to a Max of 6
Semesters Offered: On Demand
Restrictions: Permission of instructor required; Must be enrolled in one of the following Major(s): Computer Network & System Admn; Must be enrolled in one of the following Class(es): Senior

Social Sciences

SS 1001 - Orientation to the Social Sciences
Introduction to departmental requirements, relevant university resources, careers in social sciences and history, skill expectations, and portfolio development; assessment of current knowledge.
Credits: 1.0
Lec-Rec-Lab: (1-0-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Major(s): Social Sciences, Liberal Arts with History Opt, Anthropology

SS 1002 - Introduction to Law and the Legal Practice
An introduction to how one becomes an attorney, what it is like to be an attorney, and the career options available to attorneys.
Credits: 2.0
Lec-Rec-Lab: (2-0-0)
Semesters Offered: Spring
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Lec-Rec-Lab</th>
<th>Semesters Offered</th>
</tr>
</thead>
<tbody>
<tr>
<td>SS 2100</td>
<td>Introduction to Cultural Anthropology</td>
<td>3.0</td>
<td>(3-0-0)</td>
<td>Fall, Spring, Summer</td>
</tr>
<tr>
<td>SS 2200</td>
<td>Introduction to Archaeology</td>
<td>3.0</td>
<td>(3-0-0)</td>
<td>Fall, Spring, Summer</td>
</tr>
<tr>
<td>SS 2210</td>
<td>Evolution of Cities: Their origins, growth, and future</td>
<td>3.0</td>
<td>(3-0-0)</td>
<td>Fall, Spring, Summer</td>
</tr>
<tr>
<td>SS 2300</td>
<td>Environment and Society</td>
<td>3.0</td>
<td>(3-0-0)</td>
<td>On Demand</td>
</tr>
<tr>
<td>SS 2400</td>
<td>Introduction to Human Geography</td>
<td>3.0</td>
<td>(3-0-0)</td>
<td>Fall, Spring</td>
</tr>
<tr>
<td>SS 2500</td>
<td>United States History to 1877</td>
<td>3.0</td>
<td>(3-0-0)</td>
<td>Fall, Spring - Offered alternate years beginning with the 2014-2015 academic year</td>
</tr>
<tr>
<td>SS 2501</td>
<td>United States History Since 1877</td>
<td>3.0</td>
<td>(3-0-0)</td>
<td>Fall, Spring - Offered alternate years beginning with the 2013-2014 academic year</td>
</tr>
<tr>
<td>SS 2502</td>
<td>European History to 1650</td>
<td>3.0</td>
<td>(3-0-0)</td>
<td>Fall, Spring - Offered alternate years beginning with the 2012-2013 academic year</td>
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<tr>
<td>SS 2503</td>
<td>European History Since 1650</td>
<td>3.0</td>
<td>(3-0-0)</td>
<td>Fall, Spring - Offered alternate years beginning with the 2013-2014 academic year</td>
</tr>
<tr>
<td>SS 2504</td>
<td>World History to 1500</td>
<td>3.0</td>
<td>(3-0-0)</td>
<td>Fall, Spring - Offered alternate years beginning with the 2012-2013 academic year</td>
</tr>
<tr>
<td>SS 2505</td>
<td>World History Since 1500</td>
<td>3.0</td>
<td>(3-0-0)</td>
<td>Spring - Offered alternate years beginning with the 2013-2014 academic year</td>
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<tr>
<td>SS 2600</td>
<td>American Government &amp; Politics</td>
<td>3.0</td>
<td>(3-0-0)</td>
<td>Fall, Spring</td>
</tr>
<tr>
<td>SS 2601</td>
<td>Politics and Contemporary Issues of the European Union</td>
<td>3.0</td>
<td>(3-0-0)</td>
<td>Fall, Summer - Offered alternate years beginning with the 2006-2007 academic year</td>
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<tr>
<td>SS 2635</td>
<td>Comparative Politics</td>
<td>3.0</td>
<td>(3-0-0)</td>
<td>Fall, Spring</td>
</tr>
<tr>
<td>SS 2700</td>
<td>Introduction to Sociology</td>
<td>3.0</td>
<td>(3-0-0)</td>
<td>Fall, Spring</td>
</tr>
<tr>
<td>SS 3110</td>
<td>Food Systems</td>
<td>3.0</td>
<td>(3-0-0)</td>
<td>Fall, Spring, Summer</td>
</tr>
<tr>
<td>SS 3200</td>
<td>Historical Archaeology</td>
<td>3.0</td>
<td>(3-0-0)</td>
<td>Spring, Summer - Offered alternate years beginning with the 2008-2009 academic year</td>
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<tr>
<td>SS 3210</td>
<td>Field Archaeology</td>
<td>3.0</td>
<td>(3-0-0)</td>
<td>Summer</td>
</tr>
</tbody>
</table>

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SS 3215 - Archaeology Laboratory Practicum
This hands-on lab practicum course exposes students to various stages of artifact processing and analysis in archaeological research. Projects teach best practices for cleaning, identification, data analysis, report preparation, and curation, all undertaken within critical framework structured by professional ethics.
Credits: variable to 6.0; Repeatable to a Max of 12
Semesters Offered: Summer
Restrictions: Permission of department required

SS 3220 - Archaeological Sciences
Introduction to the archaeological sciences, including geo/bioarchaeology and materials science. Lectures emphasize connections between field and laboratory, and scientific and environmental perspectives on the world's peoples and cultures, both ancient and industrial. Students undertake hands-on exploration through course laboratory component.
Credits: 4.0
Lec-Rec-Lab: (3-0-3)
Semesters Offered: Fall - Offered alternate years beginning with the 2006-2007 academic year
Pre-Requisite(s): SS 2200 and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3230 - Archaeology of Industry
The study of industrial heritage using archaeological and historical perspectives. Covers theories, methods, and techniques by means of lectures, readings, and case studies. Students conduct original research, generally on Copper Country industrial sites, under the guidance of the instructor.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Pre-Requisite(s): SS 2200 and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3240 - Reading the Landscape: Anthropology, Geography, History
Landscape is a lens through which scholars study people, environment, and place. The concept transcends traditional disciplinary boundaries. Students will read and discuss different approaches to landscape, with special focus upon anthropological, geographic, and historical perspectives.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Summer - Offered alternate years beginning with the 2007-2008 academic year
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3250 - Human Origins & Evolution
A human evolution course focusing upon a summary of general bio-anthropological principles of evolutionary change, the current fossil record evidencing human evolution, and the consequences of human evolutionary change for modern human variability, health, and behavior.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2007-2008 academic year
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3260 - Latin American Cultural History
This course examines the diverse, but interconnected, cultures of Latin America. The class will examine the sources and patterns of particular cultural traditions, while at the same time understanding the trajectory of social, political, and economic transformations throughout the region.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2009-2010 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3270 - Archaeology of the African Diaspora
Forced into slavery, the 'scatterlings' of Africa adapted and struggled to thrive in the New World. Archaeologists studying the Diaspora generally examine: ethno genesis and blending of identity, migration, structural inequalities, and the construction of race and racism.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2009-2010 academic year
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3300 - Environmental Problems
An examination of local, regional, and global contemporary environmental problems. Critical consideration of underlying social, historical, and economic causes. Case studies drawn from topics such as global warming, ozone depletion, groundwater pollution, solid waste disposal, deforestation, and resource depletion. Studies proposed solutions and their impacts.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3313 - Sustainability Science, Policy, and Assessment
Foundational scientific concepts (dynamical systems and catastrophe theory) as applied to socioecological systems. Use of indicators and indices to track progress towards sustainability goals. Review of local, national, and global sustainability policies to avoid catastrophes and guide sustainable development.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2012-2013 academic year
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3315 - Population and Environment
This course investigates relationships between the world's population, population change, population distribution, resource consumption, and environmental and social consequences. Addresses local and global relationships and the population processes (mortality, fertility, and migration) involved.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2012-2013 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): (MA 1030 and MA 1031) or MA 1032 and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3400 - Contemporary Europe
Examination of the landscapes and cultures of modern Europe. Emphasizes cultural patterns and diversity, environmental quality, economic development, and forces of economic and political unification. Examines urbanization, industry, population, nationalism, and political change through regional examples.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring, Summer - Offered alternate years beginning with the 2002-2003 academic year
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3410 - World Resources & Development
Examination of the human geography and resources of various world regions. Emphasizes factors affecting prospects for development, including population dynamics, natural resource endowment, social and cultural systems, and spatial structure of society. Case studies of individual countries supplement general concepts and theories.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring, Summer - Offered alternate years beginning with the 2010-2011 academic year
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3500 - Modern American History
Surveys American history since 1945 using popular literature and film as a window onto social, economic, and political change.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring, Summer
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3505 - Military History of the U.S.
History of the American military and its place in American society in both peace and war from the colonial period until the present.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)
SS 3510 - History of American Technology
Survey of the technological changes that transformed a rural, agrarian America into an urban, industrialized nation. Focuses on how America's social values and geographical situation influenced the direction taken by its technology and engineering community and how America's industrialization, in turn, had significant effects on American society.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring - Offered alternate years beginning with the 2006-2007 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3511 - History of Science in America
Examines the development of scientific enterprises in the U.S. from the colonial period through the present day. Emphasizes institutional bases of science and the place of scientific activities within American society.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2005-2006 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3512 - Building America: The History of Planning, Engineering, and Development in the United States
This course surveys the landscapes and environments that Americans have designed, built, and inhabited. Students will consider how places both reflect and shape ideas, policy, technologies, and social relationships.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3515 - History of American Architecture
Survey of North American architecture from prehistoric times to the present. Focuses on principal architectural styles, building types, and construction technologies. Also examines ideas about architecture to understand the American past.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3520 - U.S. Environmental History
Examines how human interaction with physical environment has changed in North America over the last four centuries. Topics include uses of land by Native Americans, changes associated with European colonization, incorporation of natural resources into industrial economy, early conservation and preservation movements, and environmental concerns accompanying urbanization and industrialization.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring - Offered alternate years beginning with the 2000-2001 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3521 - Energy in American History
Examines changes in energy use throughout American history, beginning with energy use by American Indians and Europeans during colonial settlement and continuing through fossil fuels and adoption of nuclear power. Helps students see energy in all we do.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2013-2014 academic year
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3530 - The Automobile in America
Examines the automobile in diverse ways, seeing it as a complex product to be manufactured, as a stimulus to reshaping the environment, as an object that has altered social behavior, and as a problem solver and problem maker.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring, Summer
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3540 - History of Michigan
The history of Michigan from before European settlement to the present.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Summer - Offered alternate years beginning with the 2013-2014 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3541 - The Copper Country
Examines the social, labor, and technological history of the Copper Country from the frontier era until the shutdown of the mines.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3552 - Renaissance & Reformation
The history of Europe from 1300 to 1650.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3560 - History of England I
The social, economic, and political history of England from Stonehenge to 1750.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Summer
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3561 - History of England II
History of England from 1750 to the present, including political, social, and economic developments in the period of Britain's greatest influence in the world.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring, Summer
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3570 - History of Canada
Political, social, economic, and cultural development of Canada from earliest European settlement to the present.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3580 - Technology and Western Civilization
An overview of the evolution of technology in Western civilization from classical antiquity to mid-twentieth century. In addition, the course looks at ways technology influenced development of Western civilization and ways values of Western civilization have conditioned Western technology.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2013-2014 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3581 - History of Science
A survey of the development of scientific ideas (abstractions about how nature is and behaves) from the Greeks to the modern world, including major physical and life science revolutions by natural philosophers like Copernicus, Galileo, Darwin, and Einstein.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2014-2015 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

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SS 3600 - American Foreign Policy
Explores the nature, sources, and institutions associated with the making of American foreign policy, paying attention to explanations for American behavior and to current problems for policy. Reviews major events in U.S. diplomatic history.

Credits: 3.0
Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2011-2012 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

Pre-Requisite(s): SS 2600 and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3610 - International Law
Explores the principles, content, and logic of public international law, the law of nations. Students brief cases, prepare longer briefs to defend a side in a moot case, and engage in a moot court.

Credits: 3.0
Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall, Spring - Offered alternate years beginning with the 2000-2001 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3612 - International Relations
An introduction to the field and study of International Relations (IR). This course will cover major IR theories and current topics in global politics including: globalization, terrorism, human rights, and environmentalism.

Credits: 3.0
Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3630 - Environmental Policy and Politics
A broad survey of how environmental policy making actually works in the U.S. Covers both environmental policy processes and politics, and the major environmental policies themselves for control of air pollution, water pollution, hazardous wastes, and other major environmental problems.

Credits: 3.0
Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3635 - Climate Change Adaptation
An overview and case study application of climate change adaptation concepts (vulnerability, resilience, and adaptive capacity).

Credits: 3.0
Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3640 - Selected Topics in Cyber-Law
Applies legal and ethical principles to evolving computer technology. Explores current legal issues such as surveillance, privacy, free speech, crime, encryption, on line contracting, intellectual property and censorship, as well as legislative efforts to resolve these and other computing dilemmas.

Credits: 3.0
Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall, Spring - Offered alternate years beginning with the 2005-2006 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3650 - Intellectual Property Management
Covers principles of intellectual property law, addressing managerial and policy issues in copyright, trademark, trade secret, and patents. Readings and discussions also cover how these property and legal systems impact the balance between property exclusivity, technological innovation, and public access.

Credits: 3.0
Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall, Spring - Offered alternate years beginning with the 2006-2007 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3660 - Constitutional Law
Introduces the U.S. Constitution and how it has been interpreted by the Supreme Court over time. Explores historical, social and political consequences of major constitutional themes such as federalism, judicial review, and evolving view of individual rights and liberties.

Credits: 3.0
Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall, Spring - Offered alternate years beginning with the 2013-2014 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3661 - Civil Rights & Civil Liberties
Seminar focused on the rights and liberties guaranteed by US Constitutional amendments. Students learn constitutional theory and interpretation on topics of privacy, speech, media, religion, criminal justice, and gender/ethnic equality. Constitutional Law I is not required.

Credits: 3.0
Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2014-2015 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3665 - Crime, Incarceration, and Social Policy
Explores criminal and social justice policies including policing and control of crimes involving violence, drugs, sexual offenses, and terrorism. Sentencing, effects of mass incarceration, and inequalities based on race and class will also be examined in student writing and debate.

Credits: 3.0
Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2014-2015 academic year

SS 3700 - Industry and Society
Examines how the development of modern industry has transformed society by creating a new class of individuals (industrial workers), a new form of the enterprise (the modern industrial enterprise), and a new form of the state (the industrial state).

Credits: 3.0
Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2002-2003 academic year

Pre-Requisite(s): SS 2700 and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3710 - Social Problems
Examines both the social construction of social problems and substantive problems confronting modern society by considering the distinct understandings of social problems offered by the two major theoretical traditions in sociology and analyzing specific macro and micro social problems.

Credits: 3.0
Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring, Summer - Offered alternate years beginning with the 2002-2003 academic year

Pre-Requisite(s): SS 2700 and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3750 - Social Inequality
A critical assessment of social and cultural processes associated with group-based or categorical patterns of inequality. Examines the creation, persistence, and attempts at reduction of structured inequality based on categorical factors such as social class, race, ethnicity, and gender. May explore other significant sources of social inequality.

Credits: 3.0
Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2001-2002 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): SS 2700 and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3760 - Human Dimensions of Natural Resources
Uses sociological concepts to cover facets of human relationships to natural resources, including human values, beliefs, and attitudes regarding the environment; rural resource-dependent communities; natural resource professions and expert knowledge; and the history of American perspectives on the environment.

Credits: 3.0
Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)
SS 3800 - Energy Technology and Policy
The many roles of energy in our energy-dependent world, focusing on fuel and technology choices, trends, and policies. Emphasizes current energy dilemmas and environmental challenges, such as the risk of global climate change. Field trips to local solar homes and energy companies.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3801 - Science, Technology, & Society
Examines the relationship between science, technology, society, and the environment. Topics may include effects of technologies such as computers, biotechnology, and chemicals on society and nature, science and technology policy, and the history of technology and its global consequences.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3820 - Ethical, Legal and Societal Implications (ELSI) of Nanotechnology
Exploration of the implications of molecular-landscape perception of atoms and molecules as new targets of governance through precise engineering—brought about by emergent nanotechnology and nanoscience.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2014-2015 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3910 - Histories and Cultures
Covers selected topics in world history, geography, or anthropology. Important concepts are the relationship between societies and regional geography, the sources and patterns of major cultures, and transformations of social, cultural, political, and economic institutions over time. May be repeated if topic differs.
Credits: 3.0; Repeatable to a Max of 9
Lec-Rec-Lab: (3-0-0)
Semesters Offered: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3920 - Topics in Anthropology/Archaeology
Survey of a major branch of American anthropology or archaeology, or a specific time period or region. Topics may include North American prehistory, experimental archaeology, applied anthropology, economic anthropology, or other specialized themes. Readings will emphasize both theoretical and substantive contributions. May be repeated if topic differs.
Credits: 3.0; Repeatable to a Max of 9
Lec-Rec-Lab: (3-0-0)
Semesters Offered: On Demand
Pre-Requisite(s): (SS 2100 or SS 2200) and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3952 - Topics in World History
Examines major ideas, processes, and events in world history. Topics may include trade and commodities, imperialism, slavery, migration, or other subjects with transnational significance. May be repeated if topic differs.
Credits: 3.0; Repeatable to a Max of 6
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3960 - International Experience
Offers an opportunity for students to be immersed abroad in cultures that are different from their own. Students observe and engage in cross-cultural interactions that are unique to their experiences.
Credits: 3.0; Repeatable to a Max of 9
Semesters Offered: On Demand
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3961 - Preparing for Cross-Cultural Immersion Experiences
Preparation for study abroad, service learning, and cross-cultural research or internships. Students reflect on their cultures, explore how to live and work effectively with other cultural groups, discuss cross-cultural professional ethics; and consider holistic approaches to social problems and change.
Credits: 1.0
Lec-Rec-Lab: (1-0-0)
Semesters Offered: On Demand
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3969 - Topics in the Social Sciences
Examines an important theme or topic in the social sciences, such as social theory, work and society, or the engineer in American society. May be repeated if topic differs.
Credits: variable to 3.0; Repeatable to a Max of 9
Semesters Offered: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 4000 - Independent Study
Independent study of a topic of special interest with assistance and supervision from appropriate faculty.
Credits: variable to 3.0; Repeatable to a Max of 9
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required

SS 4001 - History of Social Thought
An intensive survey of the literature of 19th-20th century history of social thought, including the writings of Marx, Durkheim, Weber, and other prominent anthropologists, sociologists, and political philosophers.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2006-2007 academic year
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 4009 - Introduction to Survey Methodology
A general introduction to survey methods. Students will learn the basics of survey design from questionnaire construction to the measurement of complex social science concepts. Students will also demonstrate their ability to conduct an original survey through a class project.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

SS 4010 - Statistics for the Social Sciences
Covers basic concepts and methods used in conducting empirical research in the social sciences. Topics include research design, hypothesis testing, measurement of concepts, and computer-based data analysis. Assumes familiarity with Social Sciences concepts.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2000-2001 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): PSY 2720 or MA 2720 or BUS 2100
SS 4020 - Methods of Teaching Social Studies
Application of learning and instructional theories and practice to the teaching of social studies. Emphasis will include application of state and national education standards and relevant assessment strategies for social studies.
Requires admission in the Teacher Education program by the Department of Education.
Credits: 2.0
Lec-Rec-Lab: (0-2-0)
Semesters Offered: Fall, Spring
Restrictions: Permission of department required; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior
Pre-Requisite(s): ED 4700(C)

SS 4030 - Senior Seminar in Anthropology
Capstone course for anthropology majors. Students examine career and graduate studies in anthropology and prepare proposal for senior research project.
Credits: 2.0
Lec-Rec-Lab: (0-2-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Class(es): Senior

SS 4050 - GIS Applications for Social Scientists
Application of Geographic Information Systems in social sciences as a tool to collect and analyze qualitative and quantitative data for socio-spatial and historical research. Students gain hands-on experience in data collection, analysis, and output, spatial problem solving, and report writing.
Credits: 3.0
Lec-Rec-Lab: (1-0-2)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 4100 - American Indian Political Issues
Exploration of contemporary relationships among American Indians and members of non-Indian communities, focusing on economic resource issues and on the relationship between tribes and other political entities, with emphasis on the Great Lakes region.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2007-2008 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 4200 - Environmental Anthropology
A seminar on the study of culture and politics in marginal environments and disadvantaged communities. Draws upon research in anthropology and geography to examine the interaction in the Americas, Asia, Africa, Europe, the Pacific, and the Arctic.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): SS 2100 and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 4210 - Global Change in Culture and Society Since 1400
Explores the increasing interconnectedness of world cultures since 1400. The course examines the social, economic, and political changes that accompanied the rise of world capitalism from multiple theoretical perspectives. Themes include colonialism, agency, resistance, world-systems theory, and globalization.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2010-2011 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): SS 2100 and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 4211 - Ethnographic Methods
Field-based course that surveys basic concepts of ethnography and applies them in a class research project. Provides practical experience in field observation, interviews, field notes, and write-up of research.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): UN 1015

SS 4220 - Method & Theory in Archaeology
This course explores themes concerned with the intellectual development of archaeology, including research methods, theoretical concepts, and problems that have characterized the history of the discipline. Particular emphasis is placed on the broader social contexts in which archaeology has developed.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2009-2010 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

SS 4380 - Landscape Ecology and Planning
Basic principles of landscape ecology, including pattern, process, and scale. Students will learn how to use quantitative tools to study landscape-scale patterns and processes, and how to apply these principles and tools to conservation, resource management, and planning issues.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2013-2014 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman

SS 4390 - Seminar in Sustainability Issues
An intensive seminar focused on a sustainability issue or field, such as sustainable development, environmental justice, globalization, or other current and relevant topics. May be repeated if topic differs.
Credits: variable to 3.0; Repeatable to a Max of 9
Semesters Offered: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 4500 - Historiography
The history of historical writing from Herodotus to the present.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Class(es): Freshman

SS 4501 - Senior Thesis - History
Directed study leading to production of a senior thesis for history majors.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Major(s): Liberal Arts with History Opt; Must be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): SS 4500(C)

SS 4502 - Historical Research
An intensive seminar study of a topic of importance and special interest in the discipline. The student is expected to work directly with the instructor to produce an original research paper.
Credits: 1.0; May be repeated
Lec-Rec-Lab: (0-1-0)
Semesters Offered: On Demand
Restrictions: Permission of instructor required; May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): SS 2500 or SS 2501 or SS 2502 or SS 2503 or SS 2504 or SS 2505 or SS 3560 or SS 3561

SS 4636 - Perceptions of The Modern State and Governance
Classic and contemporary theories of the state and approaches to governance are examined.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall

SS 4700 - Communities and Research
A rural sociology course analyzing the sustainability of rural communities (socially, environmentally, economically, and culturally). The course involves participatory research conducted together with a local community organization. Students practice research skills while making a difference in improving community life.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 4900 - Seminar in Social Sciences
An intensive seminar study of a topic of importance and special interest in the social sciences. Topics could focus on the history of anthropological theory or on world religious systems in comparison. May be repeated if topic differs.
Credits: variable to 3.0; Repeatable to a Max of 9
Semesters Offered: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Freshman
SS 4910 - Senior Orientation and Assessment
Assessment of learning and preparation for post-graduate work, professional training, or graduate school.
Credits: 1.0
Lec-Rec-Lab: (1-0-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Major(s): Social Sciences, Liberal Arts with History Opt, Anthropology; May not be enrolled in one of the following Class(es): Freshman, Sophomore

SS 4920 - Internship Experience
Internship, on or off campus, providing appropriate practical, professional experience in an area related directly to a student's course of study. Students work under professional supervision. Requires a written evaluation of the work.
Credits: variable to 6.0; Repeatable to a Max of 6
Semesters Offered: On Demand
Restrictions: Permission of department required; Must be enrolled in one of the following Major(s): Liberal Arts with History Opt, Social Sciences

SS 4921 - Washington Experience - Professional Practicum
Practicum participants experience professional hands-on learning as interns in governmental, public-interest, non-profit, or national organization in DC or select cities abroad. Internship placements made through approved affiliate institution providing placements, mentorship, supervision, classes, orientation, and housing for MTU's DC interns.
Credits: variable to 15.0; Repeatable to a Max of 15
Semesters Offered: On Demand
Restrictions: Permission of department required

SS 4961 - Experiential Learning in Cross-Cultural and Community Partnerships
This course allows students with combined classroom training and at least 50 hours of field experience with cross-cultural and community partners to reflect on connections and puzzles between personal experience and scholarly writing on social change, culture, and social problems.
Credits: 2.0
Lec-Rec-Lab: (2-0-0)
Semesters Offered: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 4990 - Directed Study in Anthropology
An original study of an anthropological problem, including literature search, data collection, and analysis, culminating in a research report.
Credits: variable to 3.0
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required; Must be enrolled in one of the following Class(es): Senior

Service Systems Engineering

SSE 2100 - Industrial and Service Systems
This course provides an overview of the systems engineering process, an introduction to the service sector as an engineering field, and basic manufacturing processes. Systems Engineering approaches common to industrial and Service Systems will be emphasized.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: On Demand

SSE 3200 - Analysis and Design of Web-based Services
The strategy behind developing web-based service systems will be the focus of the course. Topics will include flowcharting, cost estimating, performance measurement, database management, and alpha and beta testing. A semester project will illustrate the use of these tools.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: On Demand
Pre-Requisite(s): CS 1121(C) or CS 1131(C)

SSE 3400 - Human Interactions in Service Systems
Service system customers and employees can benefit from user-centered design. This course explores both the psychological and physical characteristics of human beings, as well as cultural influences on their behavior. It introduces data collection methods such as surveys, focus groups, and structured interviews. It then presents how to apply human factors principles to the design process. May not take MEME4650 and SSE3400.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Pre-Requisite(s): PSY 2000 and (MEEM 2110 or ENG 2120)

SSE 3500 - Service System Operations
Focuses on the operation of service systems in a customer-focused environment. Topics will include work measurement, performance management, and process evaluation and improvement. Supply chain, demand management and lean practices will also be introduced. May not take MEME4655 and SSE3500.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Pre-Requisite(s): BA 3610 or OSM 3000

SSE 3730 - Systems Dynamics and Design
Introduces principles of systems engineering as applicable to studying the behavior of engineering systems such as transportation, utility, service, construction, and project management systems. Students are introduced to Queueing Theory, Markov Chains, and System Dynamics.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): BUS 2100(C) or MA 3710(C) or MA 2720(C) or CE 2710(C) and (MA 1135 or MA 1160 or MA 1161)

SSE 4300 - Project Planning and Management for Engineers
The various stages in a project life cycle will be defined and explored such as planning, metrics, execution, completion, and maintenance. Basic tools such as CPM, PERT, Gantt, and budgeting will be introduced. Change assimilation in the context of project management will also be discussed. Not open to students with credit in BA3620 or OSM3200.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Summer
Pre-Requisite(s): MA 2720 or MA 3710 or BUS 2100

SSE 4750 - Risk Analysis and Management
Fundamentals methods in analyzing and mitigating risks involved in services that function at the interface of human, natural and engineered systems. Relevant systems include transportation, service, utility, emergency and hazard management, and project management.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Class(es): Senior
Pre-Requisite(s): CE 3710 or MA 3710

SSE 4760 - Optimization Methods in Design and Decision Making
Decision analysis and optimization techniques, including linear programming, nonlinear programming, and dynamic programming. Computer-based solutions of design problems in various engineering specialty areas are considered.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): MA 2160 and (MA 2320 or MA 2321 or MA 2330)

Surveying

SU 2000 - Introduction to Surveying
Surveying topics will include distance measurements, leveling, angles, directions, traversing, horizontal and vertical curves, percent grade, and coordinate geometry.
Credits: 2.0
Lec-Rec-Lab: (0-1-2)
Semesters Offered: Fall, Spring

SU 2050 - Plane Surveying
An introductory course studying surveying instruments and their use in the measurement of angles, distances, and elevations. Topics include taping, leveling, traversing, construction surveys, route surveys, use of modern instrumentation, and computer applications.
Credits: 3.0
Lec-Rec-Lab: (0-1-6)
Semesters Offered: Fall
Pre-Requisite(s): SU 2000(C)

SU 2220 - Route and Construction Surveying
Study of the geometry and field stake-out techniques of circular curves, spiral curves, compound curves, reverse curves, equal-tangent vertical curves, and unequal-tangent vertical curves. Other topics include horizontal and vertical alignment design, earthwork quantities and mass diagrams.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): SU 2050 or SU 2000
SU 3110 - Surveying Field Practice
Survey projects from field to finish using current surveying equipment and software. Basic statutes and ethics governing the practice of surveying. Projects cover level networks, horizontal control, design surveys, construction layout, section subdivision, map and report preparation.
Credits: 4.0
Lec-Rec-Lab: (0-2-6)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): SU 2220

SU 3180 - Boundary Surveying Principles
Interpretation of property descriptions used to establish land boundaries. Resolving conflicts in boundary descriptions as well as conflicts in evidence. Review doctrines pertaining to transferring title and the role of the surveyor in issuing opinions on boundary location in boundary disputes.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Restrictions: Must not be enrolled in one of the following Class(es): Freshman, Junior, Senior
Pre-Requisite(s): SU 3600(C)

SU 3210 - Site Planning and Development
An examination of land development issues including: site analysis, environmental concerns, contouring, earthwork and grading, soils, route alignments, storm water management, sewer systems, zoning, and land planning. Incorporates CAD applications in the lab.
Credits: 4.0
Lec-Rec-Lab: (0-3-2)
Semesters Offered: Spring
Pre-Requisite(s): MA 3710

SU 3600 - Surveying Computations and Adjustments
Basic computations and analysis of surveying measurements by adjustment theory are introduced. Students will gain the ability to use computer software to perform the computations. Analysis of measurements and errors based on statistical principles and least squares principles will be discussed.
Credits: 4.0
Lec-Rec-Lab: (0-3-3)
Semesters Offered: Fall
Pre-Requisite(s): (SU 2000 or SU 2050) and MA 2320 and SU 3110(C) and MA 3160(C) and MA 3710(C)

SU 4000 - Geospatial Information Systems (GIS) Technology Fundamentals
Course provides review of Geographic Information Systems applications and analysis. Includes core concepts such as data acquisition and management, topology, accuracy, metadata, output, quality control, analysis methods, new and traditional software options, web mapping, and GIS implementation/management for research and production.
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: On Demand

SU 4010 - Geospatial Concepts, Technologies, and Data
High level review of geospatial data acquisition systems, sensors, and associated processing technologies. Course considers geospatial metadata generation principles, interoperability, and major tools for manipulation with geospatial data. Course may help in transition of non-geospatial majors to geospatial field.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Permission of instructor required

SU 4045 - Geospatial Data Fusion
Fundamentals of GIS data, aerial photographs, satellite imagery, airborne/terrestrial laser scanning data. Characteristics of remotely sensed data including information specific to the sensors used to obtain it. Term project on how to combine and fuse to a specific application.
Credits: 3.0
Lec-Rec-Lab: (0-2-1)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Class(es): Senior
Pre-Requisite(s): SU 4140

SU 4060 - Geodesy
Concepts of astronomy and geodesy that are relevant to the practice of surveying. Covers theory, field techniques, and computations involved in the determination of true north, an introduction to the figure of the earth and its geometric and physical characteristics, geodetic datums, and coordinate systems.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Major(s): Surveying Engineering; Must be enrolled in one of the following Class(es): Senior
Pre-Requisite(s): SU 3600(C) or SU 3250

SU 4100 - Geodetic Positioning
Introduces the instruments and procedures used in surveying projects that require a high order of accuracy. Discusses some conventional instruments and techniques but the greater emphasis is on GPS techniques.
Credits: 3.0
Lec-Rec-Lab: (0-2-3)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): SU 4060(C)

SU 4140 - Photogrammetry
Basic principles of photogrammetry and its role as a technology for spatial data collection. Use of photogrammetry in the fields of surveying, engineering, and geographic information management will be discussed.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Fall

SU 4142 - 3D Surveying and Modeling with Laser Scanner Data
Theory and application of terrestrial LIDAR scanning. Typical application scenarios are also included. Intensive lab component provides hands-on experience in LIDAR point cloud processing and visualization.
Credits: 3.0
Lec-Rec-Lab: (0-2-1)
Semesters Offered: On Demand

SU 4180 - Land Subdivision Design
Introduces the physical, economic, and social aspects of optimum land use within the framework of state and local regulations of land divisions, condominiums, mobile home parks, and residential subdivisions.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring

SU 4480 - Geospatial Science and Technology to Support Land Cadastre
Introduction and description of land rights. Land ownership, land lease, land access, traditional rights, mortgaging and land as capital, boundary descriptions, Cadastre 2014 by FIG, different examples for cadastre types over the globe, and modern technical approaches will be covered.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand

SU 4900 - Capstone Design Project
An engineering design project which integrates multiple aspects of previous surveying coursework while working with an industry partner. Includes project description, project planning, field work, office analysis, computer-aided design, final project completion and oral presentation skills.
Credits: 3.0
Lec-Rec-Lab: (0-2-3)
Semesters Offered: Fall, Spring
Restrictions: Permission of instructor required; Must be enrolled in one of the following Major(s): Surveying Engineering; Must be enrolled in one of the following Class(es): Senior

SU 4990 - Professional Practice Seminar
A review of the elements of the NCEES Fundamentals of Surveying examination (which leads to licensure as a professional surveyor), as well as a review for the Michigan Tech Surveying Engineering Exit Exam which will be administered in this course. To be taken in final semester only.
Credits: 3.0; Graded Pass/Fail Only
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring

SU 4996 - Special Topics in Geospatial Technologies
Selected additional topics of interest in Geospatial Technologies based on student and faculty demand and interest. May be a tutorial, seminar, workshop, project, or class study.
Credits: variable to 3.0; Repeatable to a Max of 6
Semesters Offered: On Demand
Restrictions: Permission of instructor required; Must be enrolled in one of the following Major(s): Surveying Engineering; Must be enrolled in one of the following Class(es): Senior
Restrictions: Permission of instructor required; Must be enrolled in one of the following Major(s): Surveying Engineering; Must be enrolled in one of the following Class(es): Senior

SU 4998 - Undergraduate Research in Geospatial Technologies
An undergraduate research experience in Geospatial Technologies. Under the guidance of a Surveying Engineering faculty member, students work on a selected/approved research problem or work directly with faculty on active research projects/grants. May require more than one semester to complete.
Credits: variable to 6.0; Repeatable to a Max of 6
Semesters Offered: On Demand
Restrictions: Permission of instructor required; Must be enrolled in one of the following Class(es): Senior

SU 4999 - Professional Practice Review
A review of all elements of the NCEES Fundamentals of Land Surveying examination, which leads to licensure as a professional land surveyor.
Credits: 1.0; Graded Pass/Fail Only
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior

Technology

TE 4996 - Special Topics in Technology
Selected additional topics of interest in Technology based on student and faculty demand and interest. May be a tutorial, seminar, workshop, project, or class study.
Credits: variable to 3.0; Repeatable to a Max of 6
Semesters Offered: On Demand
Restrictions: Permission of instructor required; Must be enrolled in one of the following College(s): School of Technology; Must be enrolled in one of the following Class(es): Senior

TE 4997 - Independent Study in Technology
Independent study of an approved topic under the guidance of a School of Technology faculty member. May be either an academic, design, or research problem/project.
Credits: variable to 3.0; Repeatable to a Max of 6
Semesters Offered: On Demand
Restrictions: Permission of instructor required; Must be enrolled in one of the following College(s): School of Technology; Must be enrolled in one of the following Class(es): Senior

TE 4998 - Undergraduate Research in Technology
An undergraduate research experience in Technology. Under the guidance of a School of Technology faculty member, students work on a selected/approved research problem or work directly with faculty on active research projects/grants. May require more than one semester to complete.
Credits: variable to 6.0; Repeatable to a Max of 6
Semesters Offered: On Demand
Restrictions: Permission of instructor required; Must be enrolled in one of the following College(s): School of Technology; Must be enrolled in one of the following Class(es): Senior

UN 1000 - Creating Your Success for Learning Communities
First year seminar course that develops community among members of residential learning communities and provides an introduction for creating academic, professional, and personal success. This course is required for all first-year and transfer (with less than 30 credits) students living in a residential learning community. Course counts as a free elective.
Credits: 1.0
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring, Summer

UN 1011 - Strategies for Success
Seminar course that provides a framework to assess the strategies a student is currently using to achieve academic, professional, and personal success. The course is designed to look at ways to improve upon a student's strategies for success or adopt new ones. This course is required for all first-year or transfer (with less than 30 credits) students who are on academic probation for the first time after fall or spring of their first year. This course is also available with permission from the Dean of Students, to any student who feels they would benefit from additional strategies for success. Course counts as a free elective.
Credits: 1.0
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring, Summer

UN 1012 - Academic Language & Practice
This course is designed for speakers of English as a second language admitted into academic study, not native speakers of English. It assesses language ability and focuses on academic language and practices.
Credits: 1.0; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Class(es): Freshman

UN 1025 - Global Issues
Study of contemporary global issues, their origins, impacts, and solutions through the thematic and comparative exploration of worldview and culture, population, globalization, development, politics and global governance, environment, and sustainability. Emphasis on global literacy and information literacy.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Class(es): Freshman

UN 1200 - Pavlis Orientation Seminar
Develops group problem-solving skills. Stresses interpersonal skills and skill assessment, communication, group process and teamwork, and action planning. Uses active, hands-on learning.
Credits: 1.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Fall, Spring

UN 2100 - Pavlis Leadership and Teamwork
Course designed for students in the Pavlis program, to develop group problem-solving skills. Stresses interpersonal skills and skill assessment, communication, group process and teamwork, and action planning. Uses active hands-on learning.
Credits: 1.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Spring
Pre-Requisite(s): UN 1200

UN 2200 - Leadership, Culture, and Technology
This course provides students with an understanding of the nature and process of leadership, and an opportunity to assess personal leadership skills/potential and develop a personal model of leadership. Leadership in other cultures and use of appropriate technology will also be explored.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring
Restrictions: Permission of instructor required
Pre-Requisite(s): UN 1200

UN 2525 - Career Development Foundations
Students will learn the process of career development and planning, which includes self-assessment, decision-making, job search strategies, and awareness of workplace issues.
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall, Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman
UN 2600 - Fundamentals of Nanoscale Science and Engineering
Team-taught introduction to the fundamentals of nanotechnology, emphasizing the interdisciplinary nature of this field. Modern instrumentation, key scientific foundations, and current and potential applications will be discussed. Real and potential societal implications of nanotechnology will be explored.
Credits: 2.0
Lec-Rec-Lab: (1-1-0)
Semesters Offered: Spring, Summer - Offered alternate years beginning with the 2007-2008 academic year

UN 2900 - Special Topics in Humanities, Arts, and Social Sciences
Examines an important theme or topic in the humanities, arts, or social sciences at an introductory level.
Credits: 3.0; Repeatable to a Max of 6
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand

UN 2990 - Special Topics - Interdiscip.
Study of interdisciplinary special topics as specified by section title.
Credits: variable to 6.0; Repeatable to a Max of 97
Semesters Offered: On Demand
Restrictions: Permission of instructor required

UN 3000 - Pavlis Leadership and Project Development
Course for students in the Pavlis Leadership program for planning and development of projects to be implemented during the summer international experience and continued development of personal leadership skills.
Credits: 1.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): UN 2100

UN 3002 - Undergraduate Cooperative Education I
Credits may count as free or technical electives based on academic department. Requires good standing, registration with Career Services, and an official offer letter from the employer.
Credits: variable to 2.0; May be repeated
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required; May not be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): UN 3002

UN 3003 - Undergraduate Cooperative Education II
Credits may count as free or technical electives based on academic department. Requires good standing, registration with Career Services, and an official offer letter from the employer.
Credits: variable to 2.0; May be repeated
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required; May not be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): UN 3002

UN 3004 - Undergraduate Cooperative Education III
Credits may count as free and technical electives based on academic department. Requires good standing, registration with Career Services, and an official offer letter from the employer.
Credits: variable to 2.0; May be repeated
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required; May not be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): UN 3002 and UN 3003

UN 3005 - Undergraduate Cooperative Education IV
Credits may count as free or technical electives based on academic department. Requires good standing, registration with Career Services, and an official offer letter from the employer.
Credits: variable to 2.0; May be repeated
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required; May not be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): UN 3002 and UN 3003 and UN 3004

UN 3100 - Foundations of Ethical Leadership
Seminar course designed for participants in the Pavlis program. Builds upon topics covered in UN2100 with an emphasis on the principles of ethical leadership. Covers topics of ethics in communication, technology, the environment, and economics in today’s interconnected, globalizing world.
Credits: 1.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Spring
Pre-Requisite(s): UN 3000

UN 3407 - Pavlis International Project Development
Course for students in the Pavlis Leadership program for refinement and finalization of projects to be implemented during the summer international experience.
Credits: 2.0
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Summer
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior
Co-Requisite(s): UN 3404
Pre-Requisite(s): UN 3100

UN 3900 - Advanced Topics in Humanities, Arts, and Social Sciences
Examines an important theme or topic in the humanities, arts, or social sciences at an advanced level.
Credits: 3.0; Repeatable to a Max of 6
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Freshman

UN 3990 - Special Topics - Interdisciplinary
Study of interdisciplinary special topics as specified by section title.
Credits: variable to 6.0; May be repeated
Semesters Offered: On Demand
Restrictions: Permission of instructor required

UN 4000 - Remote Sensing Seminar
A seminar series that covers topical issues in remote sensing, ecosystem research, and global change. Required for all students with a minor in remote sensing.
Credits: 1.0; Repeatable to a Max of 2
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall, Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

UN 4060 - Pavlis Global Leadership Practicum
Students in the Pavlis program will plan and direct a leadership program on campus for high school students and spend time abroad participating in a variety of leadership experiences including at least one major leadership project.
Credits: 9.0
Lec-Rec-Lab: (0-0-27)
Semesters Offered: Summer
Pre-Requisite(s): UN 3404 and UN 3407

UN 4100 - Leadership Capstone Project I
This course, designed for students in the Pavlis program, is the first in a two part leadership capstone experience. Students engage in discussions and make oral presentations, outline a senior project report, mentor other students and apply their leadership skills by taking on leadership roles.
Credits: 1.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Class(es): Senior
Pre-Requisite(s): UN 3407

UN 4200 - Leadership Capstone Project II
This course, designed for students in the Pavlis program, is the second in a two part leadership capstone experience. Students engage in discussions and make oral presentations, write a senior project report, mentor other students and apply their leadership skills by taking on leadership roles.
Credits: 1.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Class(es): Senior
Pre-Requisite(s): UN 4060

UN 4990 - Special Topics - Interdisciplinary
Study of interdisciplinary special topics as specified by section title.
Credits: variable to 6.0; May be repeated
Semesters Offered: On Demand
Restrictions: Permission of instructor required

UN 3404 - Cultural and Language Awareness
This course, designed for students in the Pavlis program, allows students to explore the culture of their international experience. Students will gain insight into working with and learning from different cultures to see the world and their leadership roles in new ways.
Credits: 2.0
Lec-Rec-Lab: (0-0-4)
Semesters Offered: Summer
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): UN 3100