2009-10 Academic Calendar

FALL SEMESTER 2009
August 23, Sunday–August 29, Saturday ......................... Orientation
August 26, Wednesday ............................................... Fall bills due
August 31, Monday ..................................................... Instruction begins
September 07, Monday ................................................ Labor Day
September 11, Friday, noon ........................................ K-Day recess begins
September 14, Monday ............................................... Classes resume
October 09, Friday 3:00 PM ....................................... Homecoming recess begins
October 12, Monday ..................................................... Classes resume
October 16, Friday ....................................................... Part of Term A ends
October 19, Monday ..................................................... Mid-Term grades available
October 19, Monday ..................................................... Part of Term B begins
November 01, Sunday–November 15, Sunday .............. Spring and Summer semester registration
November 20, Friday 10:00 PM .................................. Thanksgiving recess begins
November 30, Monday ............................................... Classes resume
December 11, Friday ................................................... Last day of regular classes
December 12, Saturday ................................................ Midyear Commencement
December 14, Monday–December 18, Friday ........... Final exam period
December 18, Friday ................................................... Friday Fall semester ends

SPRING SEMESTER 2010
January 06, Wednesday ............................................. Spring bills due
January 10, Sunday ...................................................... Orientation
January 11, Monday ..................................................... Instruction begins
January 18, Monday ..................................................... Martin Luther King, Jr. Day celebrations
January 19, Tuesday .................................................... Classes resume
February 03, Wednesday 10:00 PM ......................... Winter Carnival recess begins
February 08, Monday .................................................. Classes resume
February 26, Friday .................................................... Part of Term A ends
March 01, Monday ..................................................... Part of Term B begins
March 01, Monday ..................................................... Mid-Term grades available
March 05, Friday 10:00 PM ....................................... Spring Break begins
March 15, Monday ..................................................... Classes resume
March 21, Sunday–April 04, Sunday ......................... Fall semester registration
April 23, Friday ......................................................... Last day of regular classes
April 26, Monday–April 30, Friday ......................... Final exam period
April 30, Friday ......................................................... Spring semester ends
May 01, Saturday ...................................................... Spring Commencement

SUMMER SESSION 2010
May 10, Monday ....................................................... Full session begins/Session A begins
May 31, Monday ....................................................... Memorial Day recess, 1 day only
June 24, Thursday ..................................................... June 25, Friday Session A exam period
June 28, Monday ....................................................... Session B begins
July 05, Monday ....................................................... Independence Day recess, 1 day only
August 12, Thursday ................................................... Session B ends/Full Session ends
August 13, Friday ...................................................... Full Session, Session B exam period
Dear Students:

Welcome to a campus designed with you in mind. Michigan Tech is dedicated to providing exactly the kind of hands-on, practical education you need as you prepare to create your own future and a better future for Michigan, the nation, and the world.

Academically, we are responding to students’ changing educational interests and needs by adding new degrees, minors, certificate programs, and courses. Recent examples:

- Bachelor of Arts in Theatre and Electronic Media Performance
- Transatlantic dual master’s degree in forest resources and biotechnology
- Master of Science in Spatial Information Science
- Bachelor of Science in Construction Management

At Michigan Tech, learning is not limited to campus classrooms. The University’s D80 program provides a variety of exciting opportunities for study and service in other countries. And the Enterprise program offers hands-on experience working with industry to solve real-world problems.

Your physical surroundings—the classrooms, labs and study areas, residences and recreational facilities—also play a huge role in your college experience. New construction projects at Michigan Tech include:

- Apartment-style housing that will add 192 beds
- A Great Lakes Research Center that will make Michigan Tech the hub of interdisciplinary research and education focused on understanding and preserving one of the largest fresh-water supplies on earth
- A new design and office facility at the Keweenaw Research Center
- Remodeling of campus and off-campus academic and administrative buildings.

Another benefit of attending Tech is the opportunity to participate in the variety of activities that make a Michigan Tech education unique. One low Experience Tech fee covers your attendance at athletic events, arts, and entertainment on campus, use of recreational facilities at the Student Development Complex, and outdoor activities such as downhill and cross-country skiing and golf.

Michigan Tech is ranked in the top tier of US universities by US News and World Report. Its civil and environmental engineering program is ranked thirteenth in the nation. The School of Forest Resources and Environmental Science faculty ranked first among research universities for scholarly productivity last year, and the geological and mining engineering faculty ranked sixth.

I encourage you to take a tour of Michigan Tech, to see our facilities and meet our outstanding faculty members, whose first concern is helping you get a first-class education.

I wish you well!

Glenn D. Mroz, Ph.D., President

Michigan Technological University

Mission
We prepare students to create the future.

Vision
Michigan Tech will grow as a premier research university of international stature, delivering education, new knowledge, and innovation for the needs of our technological world.
Academic Programs (Undergraduate)
Associate Degrees (SAH)
Baccalaureate Degrees (BA, BS)
Certificates
Majors
Minors

Colleges and Schools
College of Engineering
  Biomedical Engineering
  Chemical Engineering
  Civil and Environmental Engineering
  Electrical and Computer Engineering
  Engineering Fundamentals
  Geological and Mining Engineering and Sciences
  Materials Science and Engineering
  Mechanical Engineering Engineering Mechanics

College of Sciences and Arts
  Aerospace Studies (Air Force ROTC)
  Biological Sciences
  Chemistry
  Cognitive and Learning Sciences
  Computer Science
  Exercise Science, Health and Physical Education
  Humanities
  Mathematical Sciences
  Military Science (Army ROTC)
  Physics
  Social Sciences
  Visual and Performing Arts

School of Business and Economics
  Accounting
  Economics
  Finance
  Information Systems
  Management
  Marketing
  Operations and Systems Management

School of Forest Resources and Environmental Science
  Applied Ecology and Environmental Science
  Forestry
  Wildlife Ecology and Management

School of Technology
  Computer Network and System Administration
  Construction Management
  Electrical Engineering Technology
  Industrial Technology
  Mechanical Engineering Technology
  Survey Engineering
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Course Descriptions

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B: Standards of Progress
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D: Campus Map

Catalog Acknowledgments

Office of the Provost and Vice President for Academic Affairs
University Marketing and Communications
The material presented in this catalog is subject to change by the University at any time.

In keeping with its responsibilities as an educational institution, Michigan Technological University is committed to a policy of affording equal opportunity to all of its employees, students, applicants for employment, and applicants for admission without regard to race, religion, color, national origin, age, sex, sexual orientation, height, weight, or marital status. The University is also committed to a policy of educating and employing handicapped individuals and veterans without discrimination. These policies are to be implemented with due regard for the relative qualifications of all involved. The Affirmative Action Officer is Sherry L. Kauppi, 207 Administration Building, Michigan Technological University, 1400 Townsend Drive, Houghton, MI 49931-1295. Telephone 906-487-3310.

MTU complies with all federal and state laws and regulations regarding discrimination, including the Americans with Disabilities Act of 1990 (ADA).
Michigan Tech was founded in 1885 in response to the first mining boom in the US—the clamor for Michigan's copper preceded the California Gold Rush by several years.

At its outset, the college trained mining and metallurgical engineers. Today, the University offers certificates, associate, bachelor’s, master’s, and doctoral degrees in arts, humanities, and social sciences; business and economics; computing; engineering; forestry and environmental science; sciences; and technology.

Michigan Tech undergraduates benefit from an education that emphasizes study across disciplines, team learning, and research. Our graduate students receive intensive, advanced instruction and the opportunity to pursue research in a wide range of academic programs. Overall, our institution has gained worldwide attention for innovative education; our faculty members strive to be mentors; our academic programs stress learning hand in hand with application; and our students learn to inquire and discover knowledge.

About Houghton, Michigan

The rigors of an education at Michigan Tech are complemented by its unique and tranquil setting. Houghton lies in the heart of Upper Michigan’s scenic Keweenaw Peninsula. The campus overlooks Portage Lake, a long, winding ribbon of water that divides the Keweenaw in half. Just a few miles from campus, on either end of the Portage, lies Lake Superior, a majestic body of water.

Upper Michigan’s expansive waters and forests offer students unparalleled opportunity for outdoor recreation, such as hunting, fishing, backpacking, hiking, camping, boating, swimming, snowshoeing, and skiing. The University owns an eighteen-hole golf course and both downhill and cross-country ski areas. It also has a full array of men’s and women’s sports programs, including Division I ice hockey.

Houghton, rated the tenth-safest college town in the nation and the safest in Michigan, is part of the Houghton-Hancock twin-city center of approximately 12,000 residents. The University’s more than 6,000 students from many states and foreign countries make the area a vibrant, multicultural community. Houghton is home to many exciting cultural activities, from Bridgefest, a summer event commemorating the building of the Portage Lake Lift Bridge, to the annual fall Parade of Nations, a celebration of Michigan Tech’s diversity.

The campus and the surrounding communities provide a rich and inviting setting in Michigan’s storied northlands.
Campus Contacts
All numbers are preceded by area code (906).

Essential Student Services

Admissions (mtu4u@mtu.edu)  487-2335
Graduate Admissions  487-2327
Transfer Admissions  487-2335
Counseling and Wellness Services  487-2538
Financial Aid Office  487-2622
Housing (Residential Services)  487-2682
International Programs and Services  487-2160
Registrar’s Office  487-2319

Colleges, Schools, Departments

College of Engineering  487-2005
Biomedical Engineering  487-2772
Chemical Engineering  487-3132
Civil and Environmental Engineering  487-2520
Electrical and Computer Engineering  487-2550
Engineering Fundamentals  487-3057
Geological and Mining Engineering and Sciences  487-2531
Materials Science and Engineering  487-2630
Mechanical Engineering-Engineering Mechanics  487-2551

College of Sciences and Arts  487-2156
Aerospace Studies (Air Force ROTC)  487-2652
Biological Sciences  487-2025
Chemistry  487-2048
Cognitive and Learning Sciences  487-2460
Computer Science  487-2209
Exercise Science, Health and Physical Education  487-2715
Humanities  487-2540
Mathematical Sciences  487-2068
Military Science (Army ROTC)  487-2650
Physics  487-2086
Social Sciences  487-2113
Visual and Performing Arts  487-2067

Schools of
Business and Economics  487-2668
Forest Resources and Environmental Science  487-2454
Technology  487-2259

University Offices
All numbers are preceded by area code (906).

Affirmative Programs  487-3310
Athletic Department  487-3070
Bookstore, Manager  487-2410
Career Center, University  487-2313
Cashiers  487-2247
Center for Orientation, Mentoring, Parents, and Academic Student Success  487-3558
Central Ticket Office  487-2073
Dean of Students  487-2951
Degree Services  487-2395
Educational Opportunity/Diversity Programs  487-3539
Enrollment Services  487-1832
Graduate School  487-2327
Health Services  483-1860
Housing and Residential Life  487-2682
Housing Facilities  487-2740
Residential Life  487-2682
Identification Cards (Tech Express Office)  487-3308
Information Technology Services  487-0076
Intramural-Recreational Sports  487-2929

Library, J. R. Van Pelt/Opie  487-2500
Access Services  487-2508
Archives  487-2505
Reference  487-2507
Lode (Student Newspaper)  487-2404
Mail Services  487-2348
Memorial Union, Director  487-2543
Museum, Seaman Mineral  487-2572
Ombudsperson  487-1246
Parking Permits  487-2319
President’s Office  487-2200
Provost’s Office  487-2240
Public Safety  487-2216
Registrar’s Office  487-2319
Research, Vice President  487-3043
Scheduling/Registration  487-2319
Sports and Recreation  487-2375
Student Affairs  487-2212
Student Activities  487-1963
Student Development Complex  487-2578
Student Entertainment Board  487-2844
Student Insurance  487-1088
Student Life  487-2687
Transcripts  487-2319
Undergraduate Student Government  487-2406
Vehicle Registration for Commuter Students  487-2319
Veterans’ Affairs  487-2319

Toll-free (for prospective students only): 1-888-MTU-1885
Email: mtu4u@mtu.edu

Michigan Tech Switchboard
906-487-1885

Emergency
Call 911
Public Safety 487-2216

Mailing Address
(Name or department)
Michigan Technological University
1400 Townsend Drive
Houghton, MI 49931-1295
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 2009-10 academic year, are linked below.

- **Associate Degrees**
- **Baccalaureate Degrees**
- **Certificates**
- **Minors**
- **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.

- **Cooperative Education (Co-op)**
- **Double Majors**
- **Second Degrees**
- **English as a Second Language Programs**
- **Michigan Tech Online Programs**
- **International Programs—Study Abroad**
- **MICUP Transfer Degree 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.
Associate Degrees
Michigan Tech offers a two-year program in the College of Sciences and Arts. Those students who wish to combine an associate degree with a baccalaureate degree should see their academic advisors.

College of Sciences and Arts
   Humanities—Associate Degree (SAH)

School of Technology
   Engineering Tech (TAET)
Michigan Tech has a variety of four-year degree programs in major fields. This section presents the requirements for a Bachelor of Science or Arts degree (BS or BA), listed alphabetically by college or school.

**Business and Economics, School of Engineering, College of**

**Forest Resources and Environmental Science, School of**

**Sciences and Arts, College of**

**Technology, School of**

Some degrees also specify requirements for particular concentrations within the major. Those students interested in obtaining double majors, adding a minor or certificate to their degree program, or pursuing a second degree, should consult with their academic advisors. Also see degree audit information and instructions.

### School of Business and Economics
- Accounting (BACC)
- Finance (BFIN)
- Management (BMGT)
- Management Information Systems (BMIS)
- Marketing (BmkT)
- Operations and Systems Management (BOSM)

### College of Engineering
- Applied Geophysics (EAG)
- Biomedical Engineering (EBE)
- Biomedical Engineering Enterprise (EBEE)
- Chemical Engineering (ECM)
- Chemical Engineering Enterprise (ECME)
- Civil Engineering (ECE)
- Civil Engineering Enterprise (ECEE)
- Computer Engineering (ECP)
- Computer Engineering Enterprise (ECPE)
- Earth Science Education (EGL2)
- Electrical Engineering (EEE)
- Electrical Engineering Enterprise (EEEE)
- Engineering (EBS)
- Environmental Engineering (EEN)
- Environmental Engineering Enterprise (EENE)
- Geological Engineering (EGE)
- Geological Engineering Enterprise (EGEE)
- Geology (EGL)
- Manufacturing—Distance (EBS6)
- Materials Science and Engineering (EMSE)
- Materials Science and Engineering Enterprise (MSEE)
- Mechanical Design—Distance (EBS2)
- Mechanical Engineering (EME)
- Mechanical Engineering Enterprise (EMEE)
- Photonics (EEEP)

### School of Forest Resources and Environmental Science
- Applied Ecology and Environmental Sciences (FES)
- Forestry (FFR)
- Wildlife Ecology and Management (FWEM)

### School of Technology
- Computer Network and System Administration (TCSA)
- Construction Management—BS (TCMG)
- Electrical Engineering Technology—BS (TEET)
- Industrial Technology—BS (TINT)
- Mechanical Engineering Technology—BS (TMET)
- Surveying Engineering—BS (TSE)

### College of Sciences and Arts
- Actuarial Science (SMA6)
- Anthropology (SANT)
- Applied/Computational Mathematics (SMA8)
- Applied Physics (SAP)
- Audio Production and Technology (SFAT)
- Biochemistry (SCH2)
- Biochemistry and Molecular Biology (SMBB)—Biological Sciences
Biochemistry and Molecular Biology (SMBC)—Chemistry
Bioinformatics (SBI)
Biology—Secondary Education (SBL7)
Chemical Physics (SCH4)
Cheminformatics (SCHI)
Chemistry (SCH)
Chemistry—Secondary Education (SCH3)
Clinical Lab Science 3+1(SCL8)
Clinical Lab Science 4+1(SCL9)
Clinical Lab Science—Secondary Education (SCL0)
Communication in Contemporary Culture (SCC1)
Communication in Human Interactions and Global Contexts (SCC2)
Communication Media (SCC3)
Computer Science (SCS2)
Computer Science Applications (SCS1)
Computer Science—Secondary Education (SCS4)
Computer Systems Science (SCSY)
Cytotechnology 3+1(SCL4)
Cytotechnology 4+1(SCL6)
Discrete Mathematics (SMA5)
English (SHU1)
English—Secondary Education (SHU3)
Environmental Chemistry (SCH5)
Exercise Science (SESC)
Fitness and Sports Management (SEH1)
General Biology (SBL1)
General Mathematics (SMA2)
Health and Physical Education—Secondary Education (SEH2)
History (SSSH)
Histotechnology 3+1(SCL5)
Histotechnology 4+1(SCL7)
Information Systems (SCS3)
Law and Society (SSS4)
Liberal Arts—Interdisciplinary (SHU2)
Mathematics—Education Preparation (SMA9)
Mathematics—Secondary Education (SMA7)
Pharmaceutical Chemistry (SCHP)
Physics (SPH)
Physics—Secondary Education (SPh1)
Polymers (SCH1)
Preprofessional (SBL5)
Psychology (SPSY)
Scientific and Technical Communication (BA) (STA)
Scientific and Technical Communication (BS) (STC)
Social Sciences—General (SSS)
Social Sciences—Secondary Education (SSS2)
Software Engineering (SCS5)
Software Engineering (SSEN)
Sound Design (SFSD)
Statistics (SMA3)
Theatre and Electronic Media Performance (BA) (SEMP)
Theatre and Entertainment Technology (BA) (SFTT)
Theatre and Entertainment Technology (BS) (SFET)
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.

Departments can offer certificates to both degree-seeking and nondegree-seeking students. Nondegree-seeking students who wish to acquire a certificate must comply with procedures for admission to Michigan Tech. Students who wish to earn a certificate must indicate their interest to the appropriate department.

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.

The following certificates are available:

**School of Business and Economics**
Certificate in International Business (CIB)

**School of Business and Economics and the School of Forest Resources and Environmental Science**
Certificate in Geographic Information Systems (CGIS)
Certificate in Industrial Forestry (CIF)

**College of Engineering**
Certificate in Design Engineering—Distance (CDE)
Certificate in Electrical Power Engineering (CEPE)
Certificate in International Sustainable Development Engineering (CISE)
Certificate in Mine Environmental Engineering (CMEE)

**College of Sciences and Arts**
Certificate in Actuarial Science (CASC)
Certificate in Advanced Modern Language—French (AFR)
Certificate in Advanced Modern Language—German (AGE)
Certificate in Advanced Modern Language—Spanish (ASP)
Certificate in Media (CMD)
Certificate in Modern Language—French (CFR)
Certificate in Modern Language—German (CGE)
Certificate in Modern Language—Spanish (CSP)
Certificate in Writing (CWR)
Coaching Endorsement (CCE)

**Interdisciplinary Certificates**
Certificate in Global Technological Leadership (CGTL)
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 enrolled in a bachelor's degree program at Michigan Tech, have indicated that they are pursuing the minor, and have completed all requirements for the minor. The award will be noted on the diploma and official transcripts.

A student must inform Degree Services of the pursuit of a minor no later than the time when degree audits are filed with the Registrar's Office. A student cannot be awarded a minor that has the same title as their major or major concentration.

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).
• 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.

School of Business and Economics
Economics Minor (BECM)

College of Engineering
Applied Geophysics Minor (EAGM)
Earth Sciences Minor (EGLM)
Electrical Engineering Minor (EEEM)
Electronic Materials Minor (MSEM)
Geological Engineering Minor (EGEM)
Manufacturing Minor (EMMF)
Minerals Processing Minor (CMMP)
Mining Minor (EMGM)
Municipal Engineering Minor (ECEM)
Polymer Science and Engineering Minor (ECMM)
Product Design Minor (EMPD)
Structural Materials Minor (MSSM)

Interdisciplinary Minors
Bioprocess Engineering Minor (IMBE)
Ecology Minor (IMEC)
Enterprise Minor (ENTM)
Hydrogen Technology (IMHT)
Nanoscale Science and Engineering Minor (IMNT)
Plant Biotechnology Minor (IMPB)
Plant Sciences Minor (IMPS)
Remote Sensing Minor (IMRS)

College of Sciences and Arts
Aerospace Studies Minor (AFAS)
American Studies Minor (SSAS)
Art Minor (FAAR)
Astrophysics Minor (SPHA)
Biochemistry Minor (BLBC)
Biological Sciences Minor (SBLM)
Chemistry Minor (SCHM)
Coaching Fundamentals Minor (PECF)
Communication Studies Minor (HUCS)
Computer Science Minor (SCSM)
Diversity Studies Minor (HUDS)
Environmental Studies Minor (SSES)
Ethics and Philosophy Minor (HUEP)
French Minor (HUF)
German Minor (HUG)
Historical Studies Minor (SSHS)
International French Minor (HUIF)
International German Minor (HUIG)
International Spanish Minor (HUIS)
International Studies Minor (SSIS)
Journalism Minor (HUJN)
Law and Society (SSLS)
Mathematical Sciences Minor (SMAM)
Microbiology Minor (BLMB)
Military Arts and Science Minor (AMAS)
Music Minor (FAMU)
Pharmaceutical Chemistry (CHPM)
Physics Minor (SPHM)
Psychology Minor (PSYM)
Social and Behavioral Studies Minor (SSBH)
Spanish Minor (HUS)
Technical Theater Minor (FATT)
Theater Arts Minor (FATA)
Colleges and Schools

College of Engineering
Minerals and Materials Engineering Building, Room 712
906-487-2005
906-487-2782 (fax)

Dean—Timothy J. Schulz
Associate Dean—Carl L. Anderson
Associate Dean—Leonard J. Bohmann

College of Sciences and Arts
Walker Arts and Humanities Center, Room 201
906-487-2156
906-487-3347 (fax)

Dean—Bruce Seely
Associate Dean—Brad Baltensperger

School of Business and Economics
Academic Office Building, Room 103
906-487-2668, 2205
906-487-2944 (fax dept.)
906-487-1863 (fax dean)

Dean—Darrell Radson
Associate Dean—Thomas Merz

School of Forest Resources and Environmental Science
U. J. Noblet Forestry Building, Room 127
906-487-2454 or 800-WOODSMI
906-487-2915 (fax)

Dean—Margaret R. Gale

School of Technology
Electrical Energy Resources Center, Room 426
906-487-2259
906-487-2583 (fax)

Interim Dean—James Frendewey
Cooperative Education (Co-op)

Michigan Tech encourages undergraduate and graduate students to participate in cooperative education, an experience which is increasingly becoming one of the most important qualifications sought by employers. The goal of the Cooperative 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 degree of complexity of work assignments are tailored to match the level of the student's training, progressing with each work assignment. Since the co-op student must complete essentially 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.

To qualify for the co-op program as an undergraduate, a student must have completed all first-year course work. Transfer students must complete at least one semester in residence at Michigan Tech. Undergraduate students in the co-op program are expected to maintain a grade point average of 2.20 or better and be in good academic and disciplinary standing with the University. 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 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.

More than 400 students participate in this program each year. Michigan Tech has entered into a cooperative education relationship with over 2000 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 the Career Center's co-op website at http://www.career.mtu.edu/coop.php.
Double Majors

- A single Michigan Tech bachelor’s degree with two majors is granted when all requirements of both majors are satisfied at the same time. A student who completes a double major will be awarded one diploma listing both majors, for example, “BS in Mechanical Engineering and 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.
- If a single department offers two distinct degrees, it is possible to complete a double major within that department by fulfilling the requirements for both degrees. However, a double major will not be granted for completing two concentrations in a single degree program.
- 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.

It is recommended that students consider double majors as early as possible in their program of study. Students desiring a double major should indicate their intent by filing a Curriculum Add/Drop form (available in the department advising offices) with the Registrar’s Office no later than the first semester of junior year. In addition, a student seeking a double major must complete a degree audit with the academic advisor in both major departments two semesters prior to the expected date of graduation.

Any subsequent changes to specified courses on the degree audit must be approved on a Petition to Alter Curriculum Requirements form by the academic advisor of the major department.
Second Bachelor’s Degrees

A student enrolled at Michigan Technological University who is currently pursuing (or already has) a baccalaureate degree can obtain a second baccalaureate degree from Michigan Tech. Students must initiate the process for obtaining a second degree by completing a degree audit with their second degree advisor. A student earning a second baccalaureate degree is awarded a separate diploma for the degree.

A student enrolled at Michigan Technological University and pursuing a baccalaureate degree can earn a second baccalaureate degree at the same time if they:

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

An enrolled student who already has earned a baccalaureate degree (either from Michigan Tech or a college or university accepted by Michigan Tech) can obtain a baccalaureate degree from Michigan Tech if they:

- Satisfy the degree requirements for the second baccalaureate program.
- Earn at least 32 of the credit hours required for the second degree through Michigan Tech without having applied those credits to any other baccalaureate or minor degree program. The academic unit offering the second degree can allow course substitutions provided that the 32-credit-hour minimum is maintained.
English as a Second Language Program
www.mtu.edu/esl

The English as a Second Language (ESL) Program at Michigan Tech provides English language instruction for international students interested in gaining the English proficiency necessary for acceptance to undergraduate or graduate study at the University, as well as for currently enrolled students interested in improving a specific language skill.

ESL classes follow Michigan Tech’s academic calendar and are scheduled during fall and spring semesters and during Track B of the summer semester. ESL courses include all language skills at intermediate, advanced, transitional, and academic support levels.

The Summer Intensive Language Experience, SMILE Program, offered from late June to mid August, prepares international students for academic study in the following fall semester. SMILE includes intensive language instruction, American culture instruction, and weekly cultural tours of the local area. The SMILE Program welcomes undergraduate, graduate, or exchange students.

For more information, contact the ESL Program at 906-487-1858 or visit the ESL website.

Michigan Tech Online Learning
www.techonline.mtu.edu

Michigan Tech Online Learning is developing new and innovative technologies to deliver “live” and on-demand classes 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. Please visit the website for more information.

International Programs—Study Abroad
www.ips.mtu.edu

With international experience increasingly desired by both students and employers, Michigan Tech makes a variety of study abroad opportunities readily accessible.

Michigan Tech offers over 134 international study opportunities in more than 35 countries, including Michigan Tech University-led programs, exchanges with partner universities around the world, and carefully selected study abroad programs offered through member consortia. Students may study abroad for as little as two weeks or as long as a year. Program costs are variable; many are about the same as tuition and fees at Michigan Tech. Financial aid may be applied to the costs of study abroad, and additional scholarships are available to qualified students.

Knowledge of a foreign language is not necessary to study aboard, though foreign study is an excellent way to improve language skills. Many programs are taught in English. All study abroad courses must be approved prior to your departure and the credits earned while abroad may be used for major or minor requirements, general education, or free electives. International co-ops and internships are also available.

MICUP Transfer Degree Program
www.outreach.mtu.edu/micup

Michigan Tech’s Michigan College/University Partnership (MICUP) Unlock Your Future Program is available to students from Delta College, Grand Rapids Community College, Wayne County Community College District, and Keweenaw Bay Ojibwa Community College. The program focuses on encouraging and supporting community college students— especially those who are from low-income families and/or are the first generation in higher education—to further their studies and obtain a bachelor’s degree.

MICUP’s seven-week, on-campus summer program enables community college students a smoother transition to a four-year institution. Unlock Your Future offers career exploration, tutoring, comprehensive academic advising, university residential experience, summer undergraduate research experience with a Michigan Tech 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 you.
For more information, contact the Educational Opportunity Department at 906-487-2920 or visit the website.

**Officers' Training (ROTC)**

[www.aux.mtu.edu/afcadets](http://www.aux.mtu.edu/afcadets) (Air Force)

[www.armyrotc.mtu.edu/](http://www.armyrotc.mtu.edu/) (Army)

The Reserve Officers' Training Corps (Army or Air Force) is open to all U.S. 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 advisors 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 Exercise Science, Health and Physical Education, 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.
Secondary Teacher Certification

www.ed.mtu.edu

Specific major and minor 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 Clinical Laboratory Science, BS in Wildlife Ecology, Applied Ecology, and Forestry)
- Chemistry (BS in Chemistry)
- Computer Science (BS in Computer Science)
- Earth Science (BS in Geology)
- Economics (BS in Economics)
- English (BA in Liberal Arts)
- Health and Physical Education* (BS in Health and Physical Education)
- Integrated Science (BS in Engineering or Sciences)
- Mathematics (BS in Mathematics)
- Physics (BS in Physics)
- Social Studies (BS in Social Sciences)
- Technology and Design (BS in Engineering)

*Teacher Certification Pending
Admissions—Getting In

Application Procedure www.admissions.mtu.edu

General information regarding first-year students, transfer, international, and other types of undergraduate student admission:

1. Complete the Michigan Tech Application for Admission any time up to one year before you plan to enroll.
2. There is no fee to apply to Michigan Tech. Applicants are encouraged to submit an online application (www.mtu.edu/apply).
3. Submit official ACT or SAT test scores.
4. Prospective First-year Students: submit the high school counselor information page to
   high school counselor or principal for processing.
5. Prospective Transfers: submit application and official transcripts to Michigan Tech Admissions Office.
6. International Students: see Admissions Procedures at http://www.ips.mtu.edu/Admissions/Apply.htm

General Information

When To Apply—Admission to Michigan Tech is made on a space-available basis. Applicants are strongly encouraged to apply prior to January 15 for priority consideration. After this date, space limitations may affect application decisions.

All applications and supporting material must be received at least thirty days before the beginning of the semester of intended enrollment. Once students are accepted for admission, every effort is made by the faculty and staff to help them utilize the varied resources offered by Michigan Tech.

The following documents must be received by the Michigan Tech Admissions office for an applicant to be considered for undergraduate admission (for information on graduate admissions, refer to the Graduate School—www.gradschool.mtu.edu/apply.html).

- **Application Forms**—Applications may be obtained from the Michigan Tech Admissions Office or online (www.mtu.edu/apply).
- **Credentials**—Materials to accompany the application include the high school counselor information page, high school transcript(s), and official ACT or SAT scores (see below).
- **Test Scores**—Scores from the ACT or the SAT college admission examinations are evaluated by Michigan Tech for admission, financial aid, and placement purposes. Applicants are required to take at least one of these tests. The Michigan Tech code number for the ACT is 2030; for the SAT it is 1464. Test registration forms are available at high school counseling offices or from the testing agencies.
  - SAT—http://www.collegeboard.com/student/testing/sat/about.html
  - ACT—http://www.actstudent.org/index.html

Advanced Placement—Michigan Tech awards college-level credit through Advanced Placement (AP), International Baccalaureate (IB), and the College-Level Examination Program (CLEP). Specific details on these programs are available online http://www.admissions.mtu.edu/apply/ap_ib_clep/ or upon request. Placement credit is granted by Michigan Tech free of charge.

No student is required to accept AP, IB, or CLEP advanced placement.

Homeschool Policy—Michigan Tech welcomes and encourages homeschooled students to apply for undergraduate admission. Homeschooled students must supply:

1. A high school transcript including a list of courses taken, grades received, or level of proficiency attained. This transcript can be from a homeschool curriculum agency or be parent (or instructor) generated. A student may apply while final course work is still in progress.
2. Official ACT or SAT test scores sent directly to Michigan Tech from the testing agency. Paper copies of scores are not considered official and are not acceptable.
3. College transcripts if any college-level course work has been taken.
4. Official final high school transcript indicating date of graduation.

First-Year Students

High School Course Recommendations

Prospective students are encouraged to complete a rigorous high school curriculum. The following high school course recommendations apply to all academic programs at Michigan Tech, although some academic program qualifications may be higher or lower than those listed here. Contact the Michigan Tech Admissions Office with any questions.

Mathematics* — Three years recommended; four years strongly recommended
Natural Science — Three years strongly recommended (including one year of biological sciences and one year of chemistry or physics)
English — Three years recommended; four years strongly recommended (classes should cover literature, composition, language usage, essay/theme writing, writing a research paper, and one-half year of speech)
Social Studies — Three years strongly recommended (including US and world history)
Computer Literacy — One year strongly recommended
Foreign Language — Two years recommended

*It is strongly recommended that students have a fourth year of college prep mathematics, the core of which should be college algebra and analytic geometry, the elementary functions, limits, and similar precalculus topics. Other topics might include probability, statistics, permutations and combinations, mathematics induction, an introduction to the use of sets, and introduction to computers and computing, or an introduction to matrices and determinants. The emphasis should be placed on basic concepts and the principles of deductive reasoning, regardless of the choice of topic.
Calculus, where offered in secondary schools, should be at least a full-year course and be taken by students who are strongly prepared in algebra, geometry, trigonometry, and coordinate geometry.

Official High School Transcript—must be submitted with all first-year applications in addition to all requirements listed under General Information (Application Forms, Credentials, and Test Scores). Applicants will be notified of their admission status as soon as completed credentials are received and evaluated by the admissions staff—typically within two – three weeks.
Transfer Applicants for Admission

Students in good standing who have satisfactorily completed work at another college or university are encouraged to apply for transfer admission. An average of at least C+ (2.50 on a 4.00 scale) is generally recommended for students applying to Michigan Tech. High-demand curricula may require an average higher than a C+ for consideration. The grade point average (GPA) earned at other institutions is neither transferable nor used in computing GPA at Michigan Tech.

Applicants must also submit their high school transcripts unless they have earned 30 or more semester credits from an accredited college or university prior to the time of application. Official transcripts from each previous college attended must be sent to the Michigan Tech Admissions Office. All transcripts become the official property of Michigan Tech and will not be returned or forwarded to another institution or party.

Transfer credit—Granted in accordance with the guidelines established by the academic departments.

1. **Specific or approved course credit** is granted for courses taken (including online courses) in which passing grades of C (2.00/4.00 scale) or higher have been obtained, provided the courses are equivalent in content, length, and prerequisites to courses offered at Michigan Tech. Any online course presented for transfer credit must be acceptable for residence credit in a comparable program at the college or university offering the course.

2. **Unassigned free elective credit** may be granted for courses that are not comparable to those offered by Michigan Tech. Such credit will apply only toward the total credits required for graduation, unless the department of a student's major authorizes the use of the credit to meet departmental requirements. All credits granted become final only after the student has demonstrated satisfactory progress at Michigan Tech.

Community College Transfers—Transfer guides are available for all Michigan community colleges: http://www.admissions.mtu.edu/transfer_students/transfer_equivalency/. The Michigan Tech Admissions Office can offer program of study suggestions to students who plan to transfer to Michigan Tech after completion of one or more years at a community college. All of the recommended courses will transfer and apply toward the intended program of BS or BA study. Admissions advisors visit most Michigan and several out-of-state community colleges to provide special counseling and services.
International Students

International Programs and Services (IPS) is responsible for recruiting, admitting, and supporting international students on campus. IPS requests and sends I-20 and DS2019 forms and is the University's official representative for the Department of Homeland Security, U.S. Citizenship and Immigration Services (USCIS). All international students must check into IPS upon arrival and will communicate regularly with IPS throughout their stay at Michigan Tech in order to meet compliance requirements for maintaining visa status. IPS conducts foreign transcript evaluations and processes transfer credit from foreign institutions for undergraduate students. IPS provides airport transportation for international students upon initial arrival, offers a thorough international orientation, and maintains an extensive support structure to help international students adapt to and become integrated into the Michigan Tech community.

Admissions Criteria—International applicants must:

- Graduate students—go to: www.mtu.edu/gradschool/
- Apply online at www.ips.mtu.edu.
- Satisfy entrance requirements comparable to those required for students from the U.S. (including application forms available at www.ips.mtu.edu), provide credentials, and produce official test scores.
- Submit official TOEFL scores or other proof of English proficiency.
- Establish their ability to cover all expenses for their first year (or in some instances two years) of study at Michigan Tech.
- Satisfy US embassies' requirements for visa issuance, including certification of financial support.

Undergraduate Admissions Procedure

- Six to twelve months before desired initial enrollment term:
  - Submit an Undergraduate Application and prepare.
  - Send all other required documents.
  - Other information, including a checklist and all necessary forms. can be accessed at our website: www.ips.mtu.edu.
- Completed applications for admission for fall semester are due by May 1.
- Completed applications for admission for spring semester are due by October 15.
- Incomplete applications will be considered for admission the following semester.
- Nonnative English speakers must take the Test of English as a Foreign Language (TOEFL) or IELTS, TOEIC, MELAB, or SAT1 to demonstrate English Language Proficiency and should have the score officially reported to Michigan Tech (Michigan Tech school code for submission of TOEFL and SAT test scores: 1464). A score of 79 or higher on the internet-based TOEFL generally is considered satisfactory for undergraduate admission to the University.* Obtain information regarding this test at www.ets.org/toefl. Send certified English translations with all credentials written in another language.

* If you score below the minimum required but above 450PBT/52iBT TOEFL or 5.0 IELTS, you will be considered for our 4 - 12 month ESL program and ESL (conditional) admission to Michigan Tech. Undergraduate applicants should apply for ESL and bachelor's degree admissions with one application. Degree program admission after successful completion of the ESL program requires a TOEFL or other score above minimum, as listed above. Michigan Tech is an official Educational Test Service (ETS) test site. Space may be limited for ESL+BS applicants. Please apply early.

Admitted International Students—An applicant is admitted to Michigan Tech only when he or she has submitted all application materials by the deadline and meets all eligibility requirements. The applicant will be sent an official acceptance letter, scholarship notification (if appropriate), and the I-20 or DS2019 and other important documents by regular airmail unless rush delivery is requested (and paid for) by the student.

First-year and transfer students must pay the enrollment deposit by the deadline to retain program enrollment status and housing reservation requests. The deadline for receipt of enrollment deposit for fall semester is May 15. For spring semester, the deposit must be received by November 15. Graduate and exchange students are exempt.

Upon arrival to Michigan Tech’s campus, accepted international students must report to the International Programs and Services (IPS) Office.
Other Applicants for Admission

Guest Students
A student who is regularly enrolled in good standing at another institution may be admitted to Michigan Tech for one semester as a guest student. A student who wishes to register for two or more consecutive semesters must apply for admission as a transfer student. A Michigan Uniform Undergraduate Guest Application form may be obtained from the Admissions Office mtu4u@mtu.edu at Michigan Tech or from any other college or university in Michigan.

Nondegree Students

Nondegree-seeking students should complete and submit an Application for Admission to the Admissions Office, but they are not required to submit high school and college transcripts. However, if they later desire to become degree-seeking students, they must satisfy the same requirements as regularly enrolled students and receive official approval from the admissions office.

High school students may be admitted to specific courses on a concurrent/dual enrollment basis with their high school, provided they also receive permission from their high school principal.

Former Students (Readmission)
Any University student whose enrollment is interrupted for one or more semesters must be readmitted to Michigan Tech through the Registrar’s Office. Students may request readmission by letter, fax, or email and should include name, ID number, and semester for which readmission is requested, or by calling the Registrar’s Office at 906-487-2319. Official transcripts from all schools attended and for all credit earned since leaving the University should be submitted to Transfer Services in the Registrar’s Office.

A student who has been suspended or requested to withdraw must obtain approval from the Office of Student Affairs in order to reenter the University by submitting a written petition to the Office of Student Affairs prior to the semester for which the student requests readmission. Please see: www.admin.mtu.edu/dos/petitionappeal.html.

Acceptance

Notification—Applicants will be notified of their admission status as soon as completed credentials are received and evaluated by the admissions staff—typically within two 2–3 weeks.

Acceptance Packet—Upon acceptance to Michigan Tech, students receive information regarding the steps necessary to enroll as well as details about course selection, extracurricular activities, housing and dining options.
Finance 101

Basic Expenses

Tuition Rates Past and Present
Room and Board
Michigan Tech Apartment Rates
Payments

How to Apply for Financial Aid
At Michigan Tech, we make it simple. Your application for admission also serves as a scholarship application. Applicants accepted for admission prior to January 15 for the following academic year are automatically considered for merit-based University scholarships. (The exception is the Michigan Tech Leading Scholars Award. See www.finaid.mtu.edu.) Awards are based on eligibility criteria and an index that considers your academic record, including ACT or SAT scores, cumulative GPA, and class rank (if available).

To apply for federal and Michigan financial aid, file a Free Application for Federal Student Aid (FAFSA) as soon as possible after January 1 and before March 1. File online at www.fafsa.ed.gov. You’ll need Michigan Tech’s Federal School Code (002292) to complete your application. Please be prepared to provide copies of recent federal tax returns and W-2 forms to the Financial Aid Office for verification purposes. We’ll let you know what we need and when. Didn’t file by March 1? You should still go ahead and file a Free Application for Federal Student Aid (FAFSA).

When you’ve completed your FAFSA and provided the requested information, we can prepare your financial aid package, including need-based scholarships, grants, loans, and work-study opportunities for which you are eligible. You’ll receive your package in mid-March. At that time, you may accept or decline any financial aid in your package.

Criteria for Financial Aid

First-Year Students—Recipients of first-year awards are selected on the basis of high school class rank, high school cumulative grade point average, national test scores, special criteria established by sponsors of scholarships, and/or financial need. Financial aid decisions for incoming students are announced in March and April for fall admission.

To enhance eligibility, applicants should take the American College Test (ACT), the College Entrance Examination Board Scholastic Apptitude Test (SAT), or the PSAT/National Merit Scholarship Qualifying Test (PSAT/NMSQT) prior to January 1 of their senior year.

Transfer Students—Scholarships for transfer students are available primarily to current or former students of Michigan community colleges. Recipients of new transfer awards are selected on the basis of college academic record. Students should apply to Michigan Tech by January 15 preceding the academic year in which the applicant plans to enroll at the University.

Enrolled Students—Enrolled students who indicate their intention to return to Michigan Tech for the following academic year by registering for fall classes prior to the registration deadline are considered on a competitive basis for scholarships. Awards for enrolled, returning students are announced in early July.

Scholarships/Grants
Michigan Tech offers scholarships sponsored by the University, individuals, companies, and by local, state, and federal agencies. The following is a selected list; for a complete list of scholarships and more information on application procedures, visit www.finaid.mtu.edu.
Michigan Tech Leading Scholar Awards—Merit-based awards covering full-time tuition, room and board, and a $1000 per year stipend, to be used for any curriculum, are given to Michigan residents who are members of the current year's graduating class from Michigan high schools. Candidates must be recommended for the award by a high school teacher by mid-October of senior year.

Presidential Scholars Program—Merit-based awards varying from $1,000 to $4,000 to be used for any baccalaureate curriculum are given to Michigan residents who are members of the current year's graduating class from Michigan high schools.

Michigan Community College Scholarships/David H. Morgan Memorial Community College Scholarships—These merit-based awards can be used for any degree curriculum. The amount of the award varies from $1,000 to complete full-time tuition.

Michigan Tech Merit Scholarships—These merit- and need-based awards, which can be used for any baccalaureate curriculum, are given to US citizens who are members of the current year's high school graduating class, and who are National Merit Scholarship Qualifying Test finalists. Michigan Tech must be listed as the first-choice university with the National Merit Corporation. The value ranges from $1,000 to $2,000.

International Ambassador Scholarships—Merit-based awards to be used for any degree curriculum are given to citizens or residents of any country except the United States. Accepted international students must obtain an application from the International Programs and Services Office. The value is from $1,500 to $6,000.

National Scholars Awards—Merit-based awards are given to non-Michigan residents of the US or residents of Canada. Awards to new first-year students are competitively awarded based on eligibility criteria as well as an index that considers the applicant's high school academic record and available test scores (ACT or SAT). First-year student awards range from $7,000 to $12,000. Transfer students must have a minimum cumulative grade point average of 3.00 (4.00 scale), based on full-time enrollment for at least two semesters. Transfer students awardees receive $6,000.

University Student Awards—This program is designed to provide financial assistance to incoming students and currently enrolled students at Michigan Tech, based on academic potential and financial need. The amount of each award is variable, depending on need, up to the amount of full tuition for Michigan residents and the difference between Michigan resident tuition and nonresident tuition for students paying nonresident rates. Recipients of this award must attend full-time, reapply each year, and meet the required minimum 2.00 cumulative GPA.

Michigan Competitive Scholarships—These scholarships range in value from $100 to $1,300. Applicants must have (1) been continuous residents of Michigan for one year; (2) taken the American College Test (ACT) by October of their senior year of high school (or earlier) and attained a qualifying score; (3) complied with all regulations of the Michigan Higher Education Assistance Authority; and (4) demonstrated financial need by completing the FAFSA prior to March 1 preceding the academic year. Students must meet the satisfactory progress requirements of this program.

ROTC Scholarships—These include scholarships for both US Army and Air Force programs.

- The US Air Force offers two- to four-year scholarships for students who qualify for an Air Force commission. Scholarships range from $9,000 per year up to full tuition and lab fees. Scholarship students also receive $900 per year for books. A $300 to $500 per month tax-free allowance is provided to all contracted cadets. High school students must apply for the scholarship by December 1 of their senior year. Interested college students may apply at any time. Students should contact the Air Force ROTC Department at 906-487-2652 or visit their website at www.aux.mtu.edu/afcadets/.

- The US Army ROTC offers scholarships which pay full tuition, fees, and $1,200 in books per year. Scholarships are offered to first through third year students who may need five years to complete their degree requirements. Once contracted, cadets will additionally receive a $300 to $500 tax-free monthly stipend depending on their year in school. High school students should apply online for a four-year Army ROTC scholarship before February of their senior year of high school (www.goarmy.com/rotc/high_school_students.jsp). Scholarships are also available for graduate students. Upon graduation and completion of all military training requirements, cadets will be commissioned as second lieutenants in the US Army, US Army Reserves or Army National Guard. Contact the Army ROTC Department at 906-487-2650 or visit their website at www.amyrotc.mtu.edu.
Other Aid Programs
To be considered for these programs, students must submit the Free Application for Federal Student Aid (FAFSA).

Federal Pell Grants—This federal government program assists undergraduates. The amount of the grant depends on the cost of attendance, expected family contribution, enrollment status, and period of enrollment. Award values can change yearly. The current maximum is $5,350. A Pell Grant does not have to be repaid.

Federal Academic Competitiveness Grants—These grants are to full-time Pell recipients who are US citizens and who have completed a rigorous secondary school program of study, graduated after January 1, 2005, and enrolled in an eligible program. The award for the first academic year of study is variable up to $750. To qualify for a second-year award, students must meet all previously defined conditions and have earned a 3.0 cumulative GPA at the end of their first academic year. The award is variable up to $1,300.

Federal Supplemental Educational Opportunity Grants (FSEOG)—These federal grants assist Pell Grant recipients with exceptional financial need. The award varies depending on the amount of funds available.

National Science and Mathematics Access to Retain Talent Grants (National SMART Grants)—This federal program supports full-time Pell Grant recipients who are US citizens enrolled in their third or fourth academic year of an eligible program and who are pursuing an eligible major with at least a 3.0 cumulative GPA. The award value can range up to $4,000 for each of the third and fourth academic years.

Michigan Educational Opportunity Grants (MEOG)—These grants provide aid to Michigan residents with exceptional financial need who are enrolled at least half-time. The award is variable up to $1,000 a year.

Michigan Adult Part-Time Grants—Michigan residents with financial need who have graduated from high school at least two years prior to applying and will attend the University part-time (3–11 credit hours) can be eligible for this aid program, which awards up to $600 per year.

Ray E. and Eleanor Cross TECHAID Student Loans—The University has need-based loan funds available to qualified students who are enrolled at least half-time. Loans will be determined on the basis of financial need.

Federal Perkins Loans—These need-based loans are provided by federal and University funds. Undergraduate students may borrow up to a cumulative maximum of $20,000. Interest does not accumulate until repayment period begins after graduation. Deferment of repayment is permitted for certain kinds of federal and volunteer service.

Stafford Loans—Students may be eligible for a subsidized or unsubsidized student loan from the William D. Ford Federal Direct Loan Program. The subsidized loan is based on financial need. The unsubsidized loan is not need-based.

PLUS Loans—These federal loans are available to parents to help pay the educational costs of their dependent students enrolled at least half-time.

Work-Study Programs: Federal and Michigan—These programs, based on financial need, provide assistance through employment on campus. Every effort is made to place students in jobs related to their skills, interests, and field of study. Work-Study participants generally are employed eight hours per week and receive biweekly paychecks.

Veterans Administration Education Benefits—Various programs are available for veterans, reservists, and their dependents. Information and applications can be obtained from state veterans affairs offices or the coordinator for veterans affairs at Michigan Tech.

National Guard Programs—Information about these programs can be obtained from state education offices.

Vocational Rehabilitation Educational Benefits—Financial assistance is available on a need basis to students with physical or mental disabilities resulting in an impediment to employment. Information can be obtained from state rehabilitation offices.

Bureau of Indian Affairs Programs—Financial assistance based on financial need is available to students who are qualified Native Americans. Students should contact their tribal education office for application procedures.
Keeping Your Aid

Required Credits for Assistance—Students must be enrolled each semester in the number of billable credit hours listed below to receive the full value of their awards.

<table>
<thead>
<tr>
<th>Scholarship Type</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scholarships</td>
<td>12</td>
</tr>
<tr>
<td>Federal Perkins Loan or Tech Aid</td>
<td>6</td>
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<tr>
<td>Federal SEOG</td>
<td>6</td>
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<td>Federal Pell Grant</td>
<td>6 – 12</td>
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<tr>
<td>Full grant</td>
<td>12</td>
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<tr>
<td>Three-quarter-time grant</td>
<td>9 – 11</td>
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<tr>
<td>Half-time grant</td>
<td>6 – 8</td>
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<tr>
<td>Less than half-time grant</td>
<td>1 – 5</td>
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<tr>
<td>University Student Award</td>
<td>12</td>
</tr>
<tr>
<td>Michigan Competitive Scholarship*</td>
<td>12</td>
</tr>
</tbody>
</table>

* Students carrying 6 – 11 credits may receive a reduced MCS award.


At Michigan Tech, in order to maintain consistency, a minimum requirement for financial aid has been established. However, there may be some types of aid (e.g., scholarships) with more stringent requirements: see Appendix B for details.
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 130 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 Office of Student Affairs.

Academic Work

Attendance—Students are expected to attend all classes, including recitation and laboratory sessions, beginning on the first day of regular instruction as stated in the University Academic Calendar. The University shall not schedule, nor shall the student participate in, any official function during the scheduled final examination period. Events where students are officially representing the University scheduled on dates that are out of University control are exempted.

Absences—If possible, students should contact the instructor prior to the absence and arrange a mutually acceptable makeup procedure. Otherwise, students should account for the absence at the first opportunity. Students who are unable to notify instructors concerning their absence from class or who must notify several instructors on short notice should contact the Office of Student Affairs. Students having excused absences, as defined in the Michigan Tech Student Planner and Handbook’s "Attendance Policy," are permitted to make up graded work.

Academic Integrity—Students who cheat, plagiarize, or fabricate data, as well as students who help others cheat, plagiarize, or fabricate, can receive sanctions ranging from a warning to a special failing grade to expulsion from the University, depending on the severity of the offense. See the Michigan Tech Student Planner and Handbook or the Academic Integrity Policy.

Individual Efforts—The University expects that students’ work on individual assignments and examinations will be their own private efforts that will follow acceptable practices. While group efforts and study groups are often appropriate and acceptable, students are expected to submit their own work. At times, it is difficult to differentiate between legal study aids and illegal "scoop" (old course materials including tests and lab reports). When in doubt, confer with the course instructor.
Weather Closure Policy—The president, senior vice president/provost, or their designated representative may decide to declare University closure 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 local media. Faculty and students will be excused from reporting to class.
Academic Preparation

Advising  [www.sa.mtu.edu/dean/advising](http://www.sa.mtu.edu/dean/advising)
Upon enrollment, students are assigned academic advisors by their major departments. Students are urged to consult their advisors regarding all academic concerns.

Summer Preparatory Program: MaCH-1  [www.math.mtu.edu](http://www.math.mtu.edu)
MaCH-1 is a seven-week summer program offering math, chemistry, English, and/or PE for college credit to students who will be entering college the following fall. Participants are placed into a math course based on their ACT scores, providing the necessary background for a rigorous, university-level science or engineering program. A weeklong precalculus workshop is also offered. With small classes, frequent one-on-one tutoring, and seminars on college life, MaCH-1 offers 4-7.5 credits, gives students an opportunity to refresh mathematics skills or complete prerequisite courses, experience college life in a relaxed environment, and develop confidence in their abilities.

Orientation  [www.orientation.mtu.edu](http://www.orientation.mtu.edu)
Orientation is an informative, educational program designed to introduce new students to campus, academic life, and their classmates. Attendance at the weeklong Orientation program is required for all new first-year students. Transfer students with more than 30 credits can attend a one-day Orientation program or complete an online orientation. During Orientation, students will learn about University policies, campus resources, support services, and extracurricular activities. Students will meet with their academic advisor(s) to discuss departmental expectations and curriculum. Students will also have the opportunity to meet new people, to become familiar with their new community, and to attend programs regarding the social and academic transitions to college life.

Learning Centers  [www.admin.mtu.edu/dos/learningctrs.htm](http://www.admin.mtu.edu/dos/learningctrs.htm)
Because the mind does not develop in isolation but as a result of our interactions with others, Michigan Tech has many learning centers offering peer and professional academic coaching through weekly appointments, team learning groups, and walk-in tutoring for the following areas: biological sciences, chemistry, civil and environmental engineering, computer science, electrical and computer engineering, mathematics, mechanical engineering, physics, and writing.

ExSEL  [www.exsel.mtu.edu](http://www.exsel.mtu.edu)
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 roles through an exclusive summer community internship program, and as mentors, teaching assistants, and student employees.

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 Office of Student Affairs at [www.sa.mtu.edu/dean/list/](http://www.sa.mtu.edu/dean/list/).
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 designations are determined by the student’s 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:

<table>
<thead>
<tr>
<th>GPA</th>
<th>Honor Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.9–4.0</td>
<td>Summa Cum Laude (highest honors)</td>
</tr>
<tr>
<td>3.7–3.89</td>
<td>Magna Cum Laude (high honors)</td>
</tr>
<tr>
<td>3.5–3.69</td>
<td>Cum Laude (honors)</td>
</tr>
</tbody>
</table>

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

Required Course Withdrawal—The Office of Student Affairs 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 dismissal or suspension from the University (see below).

A student seeking an undergraduate degree is placed on academic probation when any of the following is true:

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 will be removed from probation when all of the following are true:

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 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 re-enroll 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—Appeals of academic suspension/dismissal will be considered if students can document that there are unusual or extenuating circumstances surrounding their recent academic performance. They must also be confident that they will be able to show significant academic progress. Students wishing to make such an appeal must do so in writing to the dean of student affairs. A convenient petition form is found at www.admin.mtu.edu/dos/petitionappeal.html.
Reinstatement—A student suspended for unsatisfactory academic progress may apply for a reinstatement through a written request to the vice president for student affairs after a period of nonenrollment. A student who is reinstated after academic suspension will be reinstated on academic probation, and shall be considered as having enrolled under the catalog and curriculum in effect at the time of re-enrollment. A convenient petition form is found at www.admin.mtu.edu/dos/reinstate.

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

Recognizing that not all first-time students are prepared for a successful academic experience, academic renewal is designed to give undergraduate students a reasonable second chance by providing an opportunity to remove a certain portion of course work from grade point average computation. If the qualifications are met, a student may have grades for a maximum of up to two calendar years as a baccalaureate degree candidate and one calendar year as an associate degree candidate removed from all calculations regarding academic standing and grade point average. Once elected, academic renewal is irrevocable.

The qualifications for Academic Renewal are:

1. The petitioner must be an enrolled undergraduate student.
2. The request must be invoked prior to graduation and is not available to students who have completed all requirements for a Michigan Tech bachelor's or associate's degree.
3. A minimum of five years must have elapsed since the most recent course work to be disregarded was completed.
   Renewal will affect only those courses taken prior to the five-year absence and may be elected only once in a lifetime.
4. A student must have an overall GPA below 2.00 for the renewal period. If more than one term is to be disregarded,
   they must be consecutive, completed within a maximum of two calendar years for baccalaureate degree candidates or one calendar year for associate degree candidates, with no intervening enrollments at Michigan Tech.
5. A student receiving a baccalaureate or associate degree from Michigan Tech must meet the University residency
   for graduation requirements in the interval between the most recent course work to be disregarded and completion
   of courses at Michigan Tech.

All courses remain on the student's permanent record and grades received during the renewal period are annotated with an "R" to indicate that academic renewal was granted for the approved period. The grades received are excluded from University grade point average computations and academic standing is initialized to good standing. Renewal applies to all courses taken during the period for which it is granted, regardless of the grade earned. Course credit is granted for those courses subjected to renewal in which passing grades of C (2.00/4.00 scale) or higher have been obtained and are not subject to the existing Repeat Policy rules. The credit granted may be used towards graduation requirements.

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

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. If they did not leave voluntarily, they must seek re-enrollment through the Office of Student Affairs. Requests are evaluated on a case-by-case basis.

Conduct — http://sa.mtu.edu/dean/judicial/policies/

Attendance at Michigan Technological University is both voluntary and optional. Each member of the University community, by his or her matriculation at the University or by otherwise availing themselves of the benefits of the University, indicates that they agree to be bound by the Code of Community Conduct and all other relevant policies, rules, or regulations. The University considers freedom of speech and civil discourse to be essential to educational development and thus recognizes and values both freedoms provided by, and limits consistent with, the First Amendment. Students are free to engage in peaceful and orderly protest, demonstration and picketing that is consistent with the Code of Community Conduct and does not disrupt functions of the University. However, students and others are not permitted to engage in conduct that disrupts the University, the University community, or any of its constituent parts.

Sex Discrimination/Sexual Harassment—Michigan Tech must provide a fair and responsible environment for all of its students. Federal and state laws prohibit discrimination in the use of educational facilities because of gender.
Discriminatory treatment on the basis of one's status as cited in the Michigan Tech Equal Opportunity statement is prohibited. Title VII of the Civil Rights Act expressly prohibits sexual harassment. According to the Michigan Tech Sexual Harassment Policy, unwelcome sexual advances, requests for sexual favors, and other verbal and physical conduct of a sexual nature constitute sexual harassment when submission is either explicitly or implicitly a basis for academic advancement (e.g., for better grades, advancement in an academic program); or submission or rejection affects the targeted person's employment (e.g., their evaluation, advancement, salary); or the conduct has the purpose or effect of unreasonably interfering with the targeted person's work performance or learning environment; or it creates an intimidating, hostile, or offensive work, academic, or residential living environment. For information on the University's sexual discrimination policies, see the Michigan Tech Student Handbook, "Student Rights and Responsibilities in the University Community" section, or contact the offices of Affirmative Programs or Student Affairs.

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 take advantage of a substance abuse consultation and counseling available to them through Counseling and Wellness 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" or the pamphlet, "Policy and Procedure concerning Drugs and Alcohol," available in the Office of Student Affairs.

Disabilities (ADA)

Michigan Tech complies with all federal and state laws and regulations regarding discrimination, including the Americans with Disabilities Act of 1990 (ADA). Michigan Tech is committed to a policy of educating individuals with physical or learning disabilities without discrimination. Students with documented disabilities should contact the Student Affairs Office/Dean of Students for assistance and accommodations. It is the student's responsibility to inform the Office of Student Affairs of their class schedule for each semester in which accommodations are sought.

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.

Official Transcripts—Transcripts are provided free of charge upon request from the Michigan Tech Registrar's Office. 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.

Online Request—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 Registrar's Office at 906-487-2319.

Students who attended prior to 2003 may request a transcript in person, by mail, or by fax.
**Request in Person**—Come to the Registrar's Office 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.

**Request by Mail**—To request a transcript by mail, include your name, Michigan Tech Student ID number, address where you would like the transcript mailed to, your signature, and an address or phone number in case we need to contact you. The mailing address is Michigan Technological University, Registrar's Office, 1400 Townsend Drive, Houghton, Michigan 49931.

**Request by Fax**—To request a transcript by fax, include your name, Michigan Tech Student ID number, address where you would like the transcript mailed to, your signature, and an address or phone number in case we need to contact you. The fax number is 906-487-3343. You may also request that any unofficial transcript be faxed.

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**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)—given only when a student is unable to complete a segment of the course because of circumstances beyond the student's control. Course work must be made up by the close of the next three semesters in residence or the I grade becomes a failure (F). A grade of I may be given only when approved in writing by the department chair. Incomplete grades at graduation are considered F grades in the final GPA.
- **IS** (in-session)—given when course remains in session after the term's final grade deadline.
- **X** (condition)—no grade points/credit; 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. The X grade becomes a failure (F) if it is not made up within the next semester in residence. An X grade is computed into the GPA as 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 eighth week; after the eighth week, a student may only request a late drop from the
Office of Student Affairs, 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 Option**—Courses are typically taken for audit by students wishing to refamiliarize themselves with the material. A course taken as an audit may be retaken at a later date for credit subject to the approval of the student's major department. Students auditing courses will be charged the same tuition as credit courses. Students have six weeks after classes begin to change their registration (audit versus letter grade). After that time, changes in registration must be approved by the instructor.

**Pass-Fail Option**—The purpose of the pass-fail option is to encourage the student to explore areas of study outside the major field without the pressure of competition for a letter grade. Students have one week after classes begin to change their registration (pass-fail versus letter grade). After that time, changes in registration must be approved by the instructor.

No course taken for a letter grade may be repeated under the pass-fail option. Courses must be elected with the approval of the advisor. The courses available under this option are elective courses not specifically named by the student's major department as required for a degree or otherwise excluded by the department (free electives only). No university-wide credit requirement can be met with an S grade.

**Graduation Requirements**

The Michigan Tech 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 University 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 Technological University. Study abroad, national exchange, 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 degree candidate is expected to:

1. Successfully complete the required courses prescribed for their chosen curriculum. Petitions for exceptions must be approved by the department advisor and department chair or school dean and submitted for file with Degree Services.
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 an Application for Graduation with the Degree Services Office for each degree/certificate program enrolled in.
6. Have an approved Degree Audit on file in the Degree Services Office for each degree/certificate program in which enrolled.

Undergraduate Commencement Eligibility Requirements

Michigan Tech conducts two commencement ceremonies each year which 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 Degree Services Coordinator 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 degree requirements.
• Have all required degree paperwork on file in the Degree Services Office two semesters prior to the expected graduation term. **Required degree paperwork** includes an application for graduation and a department approved degree audit form for each degree being pursued and any applicable minor audit forms, double major audit forms, certificate forms, and petitions to alter curriculum requirement forms.

**Participation in a commencement ceremony is NOT equivalent to graduation. Since the ceremony occurs 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. They are:

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. Students may request to inspect their records from the appropriate records custodian. The Registrar's Office will provide assistance in identifying the correct official to whom requests should be directed.
2. The right to request the amendment of the student's education records that the student believes is inaccurate or misleading.
   a. Students may ask the University to amend a record that they believe is inaccurate or misleading. They should write the University official responsible for the record, clearly identify the part of the record they want changed, and specify why it is inaccurate or misleading.
   b. If the University decides not to amend the record as requested by the student, the University will notify the student of the decision and advise the student of his or her 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 consent to disclosures of personally identifiable information contained in the student's education records, except to the extent that FERPA authorizes disclosure without consent.
   a. One exception which permits disclosure without consent is disclosure to school officials with legitimate educational interests. School officials are individuals employed by the University as researchers, teachers, advisors, counselors, placement personnel, deans, department chairs,
administrative officials responsible for some part of the academic enterprise or one of the supporting activities; support staff and student personnel employed to assist University officials in the management of educational records; a person, company, or agency with whom the University has contracted for a service; college or University committees (including student members), a person or company with whom Michigan Tech has contracted (such as an auditor, attorney, or collection agent.)

b. 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 responsibility.

c. The University may disclose education records in certain other circumstances which are noted in full text of Michigan Tech’s Privacy and Release of Student Educational Records policy.

4. The right to file a complaint with the U.S. Department of Education concerning alleged failures by the University to comply with 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, 20202-4605.

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, electronic mail 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 at: http://www.mtu.edu/registrar/

**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 at the time of printing, 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:
www.mtu.edu/registrar/students/registration/prepare/

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 eighth 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 eighth 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 eighth week of a semester, a student may request a late drop from the Office of Student Affairs 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**—It is recommended that these courses are satisfactorily completed before a student registers for a more advanced course. Students who earn a CD or D in a prerequisite course are encouraged to 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.

Co-requisites: 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") which 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.

For forms go to: [http://www.mtu.edu/registrar/pdfs/curriculum_add_drop_form.pdf](http://www.mtu.edu/registrar/pdfs/curriculum_add_drop_form.pdf)

**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 prior to the end of the sixth 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—If a student terminates course work during the semester, registration must be formally withdrawn. Failure to submit a Student Withdrawal form may result in F grades and in payment of tuition and fees which otherwise might be avoided. Withdrawals are processed according to an established refund schedule. Notifying the Registrar’s Office helps ensure a smooth withdrawal-readmission process. Students may do this over the telephone, through the mail, or by fax, but the preferable method is in person. If students are not planning to return, a formal withdrawal assures students of receiving any refunds due in a timely manner.

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.
Student Life

Activities www.studentactivities@mtu.edu

Michigan Tech offers opportunities for students to participate in a multitude of activities. University Calendar, an electronic calendar reached from Michigan Tech’s homepage, lists University events, including student activities. Students are encouraged to add their own organization’s events to this calendar.

Looking to get involved? Well, you found the right place! The Student Activities Office, located in the Memorial Union Building Room 112, offers a variety of activities for you to get involved with on campus and in the community. Stop in and see us, call us at 906-487-1963, or email activities@mtu.edu. We look forward to meeting you!

Student Organizations www.sa.mtu.edu/stulife/stuorg/

More than 180 student groups are registered on campus, including political, cultural/ethnic, social, special interest, media, honorary, religious, service, leadership, and professional organizations, as well as fraternities, sororities, and club sports groups. Many of these groups become involved in new student orientation, Homecoming, Winter Carnival, and other events.

Undergraduate Student Government (USG) www.usg.mtu.edu/usg

USG is the voice of the student body. This group oversees the disbursement of the revenue collected through the student activity fee and works with students to help resolve issues. The USG office is located on the first floor of the Memorial Union Building.

Tech Traditions

K-Day— www.kday.mtu.edu/
At the start of the fall semester, all students are invited to McLain State Park on Lake Superior for a day of fun, sun, music, games, and food. Student organizations sponsor booths so students can learn about the varied opportunities available on Tech’s campus. The day is a celebration of the beautiful Keweenaw Peninsula, home to Michigan Tech. Classes are canceled at noon so that students and faculty can celebrate and participate in the activities.

Parade of Nations—The Parade of Nations and Multicultural Festival, held in September, celebrate diversity with a colorful parade, complete with floats, bands, and flag-bearing students, representing our student nations (nearly eighty). Following the parade, students, faculty, and members of the community gather for a celebration with food, culture, music, and dance.

Homecoming— www.homecoming.mtu.edu/
Few homecoming festivities on any campus can rival Michigan Tech’s for zaniness and all-around fun! In addition to the Homecoming Court and football game, there are also a hobo parade, in which students dress in their worst clothes, a charity canned food drive, a cardboard boat race, and a three-legged race.

Family Weekend—During a designated weekend in the fall semester, parents and families are invited to the Keweenaw Peninsula to explore campus, attend cultural events, cheer the Husky teams to victory, cruise the Keweenaw Waterway, and tour the Copper Country as it shows off its vibrant fall colors. It is a weekend filled with fond memories of Michigan Tech and family fun, and it’s a great opportunity to visit with Tech students.

Winter Carnival—No Michigan Tech tradition can match Winter Carnival for national fame and overall involvement. Winter Carnival started in 1922 and has grown to become one of the largest annual winter festivals in the nation. It features huge, intricate snow statues on campus and in the local area, a home hockey series against a tough WCHA team, men’s and women’s varsity basketball, skits, broomball and other sports, sleigh rides, a Winter Carnival Queen, and more midwinter fun than you’d think was possible! Winter Carnival is held in early February during a two-day class break.
Spring Fling—On a Friday afternoon late in spring semester, students end the academic year and welcome warmer weather by engaging in activities including pie-throwing at professors, mud volleyball (better known as oozeball), and listening to bands. Various student organizations participate in this light-hearted event with food and entertainment for a campus community eager to relax and have fun before the serious business of final exams begins.

Visual and Performing Arts  www.vpa.mtu.edu
The Department of Visual and Performing Arts presents a variety of theatrical and musical performances and art exhibits for the campus and local community throughout the year. Programs offered include:

Music—Students, faculty, and community residents participate in musical ensembles including Concert Choir, Wind Symphony, Huskies Pep Band, Jazz Lab Band, R&D Big Band, the Keweenaw Symphony Orchestra, and other jazz and chamber groups. The department also sponsors a performance series for UP and northern Wisconsin musical groups.

Theater—A varied season each year offers a full range of theatrical genres and styles including comedies, classics, musicals, and experimental productions. Guest artists are invited to perform with students.

Visual Arts—Courses in watercolor, sketching and drawing, three-dimensional design and sculpture, ceramics, and graphic design are offered each year. In addition, the visual arts program sponsors residencies and workshops by professional artists and offers opportunities for students to exhibit their work, as well as sponsoring the Great Lakes Showcase, an exhibition for professional artists.

Students play significant roles as managers, designers, production staff, and performers, working side-by-side with the faculty in art, music, and theatre.

Cultural Enrichment
The University sponsors a wide variety of cultural events and activities including art exhibits, dance and theater touring companies, musical ensembles, performing artists, comedians, and lectures by topical (and often controversial) speakers. The beautiful Rozsa Center for the Performing Arts is host to many of these events, allowing our students to broaden their cultural education and enjoy an amazing array of high-quality entertainment. This state-of-the-art facility not only enhances the quality of life on Michigan Tech’s campus and the local community, it also provides our students numerous educational and practical opportunities for hands-on experience in backstage and front-of-house crews.

Athletics  www.michigantechhuskies.com/

Intercollegiate Athletics (NCAA)  www.athletics.mtu.edu/
Michigan Tech has a thirteen-sport intercollegiate athletic program, highlighted by its Division I men’s ice hockey team, a program that has captured three national championships. Other men's programs include football, basketball, cross-country, track and field, tennis, and Nordic skiing. A strong women's program, which participated in nine NCAA tournaments in basketball and five in volleyball in the 1990s, includes cross-country, tennis, Nordic skiing, and track and field.

Intramural-Recreational Sports Services Department  www.aux.mtu.edu/im/
The Intramural-Recreational Sports Services Department will provide a wide variety of recreational activities that will appeal to the leisure-time pursuits of the students, faculty, and staff.

We encourage participation be fun, fitness, and friendship. We promote and honor individual and team sportsmanship. We provide the opportunity for students to compete against and interact with other students, thus promoting good citizenship and socialization. Student employees develop social and leadership skills that are essential for lifelong learning.

The Intramural-Recreational Sports Services program is designed to be consistent with the educational objectives of Michigan Technological University

Recreational Facilities  www.sportsrec.mtu.edu/
The University owns and operates multiple athletic facilities and recreation areas for the benefit of its students, faculty, and staff. Facilities include the Student Development Complex, the Gates Tennis Center, and numerous other indoor and outdoor facilities, both on and off campus, for team sports, skiing, golf, tennis, and bowling. Mont Ripley, Michigan Tech’s own ski slope and the only ski mountain in the Midwest owned by a university, is convenient to campus and enjoyed by skiers and snowboarders.

**Student Development Complex (SDC)**—A 235,000-square-foot, indoor sports arena located on the Michigan Tech campus. Students may use the facilities free of charge. The SDC features the following:

- fitness center
- racquetball and squash courts
- basketball and volleyball courts
- running track
- swimming pool (8-lane, 25-yard)
- diving pool
- varsity gym
- dance room
- rifle range
- ice arena
- locker rooms with showers and saunas
- sports equipment rentals
- University Images (Michigan Tech apparel shop)

**Gates Tennis Center**—Located near the SDC, features:

- tennis courts, indoor (4)
- ball machine
- locker rooms with showers
- pro shop for racquet stringing and repairs

**Other facilities** (on and off campus)

- bowling alley (6 lane) in the Memorial Union Building
- golf course (18-hole), Portage Lake Golf Course, south of Houghton
- downhill ski area at Mont Ripley
- cross-country ski trails (35 k) near the SDC
- tennis courts, outdoors
- play/practice areas
- softball fields
- football/track stadium
- soccer fields

**Health Care**

**The Houghton Community Health Center**—Located on the Michigan Tech campus adjacent to the SDC on MacInnes Drive, the Health Center is open Monday through Friday from 8:30 AM to 5:30 PM and provides primary medical care for the community and Michigan Tech students, their spouses, and their dependents on a fee-for-service basis. Fees are payable to Portage Health and are not billed by the University (906-483-1860).

An after-hours walk-in clinic and hospital emergency care are provided by Portage Health at 500 Campus Drive, Hancock, (906-483-1000), [www.portagehealth.org](http://www.portagehealth.org).

**Student Health Insurance**—All students are eligible to enroll in a group health insurance plan facilitated by the University. All international students are required to purchase the University health insurance policy unless they provide proof of comparable coverage applicable in the United States. The plan is optional for domestic students, their dependents, and dependents of international students. For more information, see [www.admin.mtu.edu/hro/stud%20insurance/index.shtml](http://www.admin.mtu.edu/hro/stud%20insurance/index.shtml).
Housing Policy—All unmarried students are required to live in University residence halls during their first year of attendance at Michigan Tech. This policy does not include transfer students, graduate students, or commuting students living at home with their parent or guardian.

Students currently living in the residence halls are guaranteed a place as long as they sign up for housing by the end of spring semester. Students should clarify their status with the Office of Housing and Residential Life prior to making an off-campus housing commitment.

Residence Hall Contract—A residence hall application and contract for accommodations will be sent by the Admissions Office when the applicant is accepted for admission. Priority residence hall and roommate preference requests are considered based on the date a completed contract is received.

Residence Halls
Facilities—Douglass Houghton Hall, McNair Hall, and Wadsworth Hall together offer accommodations for more than 2,000 students. Each residence hall has comfortable rooms, large lounges, a dining room, laundry facilities, and recreation areas. Wadsworth Hall has rooms with a private bath. All residence halls are smoke-free environments.

LIFESTYLE OPTIONS—Unique living options include the Community Governed Area, alcohol-free housing areas, and the Learning Communities.

Alcohol-free housing is offered in all three of our residence halls. The use and/or possession of alcohol and/or alcohol-related items in the house are not permitted by the residents or their guests.

LEARNING COMMUNITIES are unique residence hall living areas designed to enhance life at Michigan Tech by grouping students with common interests. Learning Communities blend programming with additional staff to help students achieve personal and academic success.

Computer Science Learning Community (CSLC)—The CSLC brings together students, staff, and faculty who share academic interests in the fields of computer science, software engineering, and computer systems science. The CSLC is located in East McNair Hall.

Forest Resources and Environmental Science Learning Community (FRES)—FRES is a close-knit community specifically designed for students seeking degrees in forestry, applied ecology and environmental sciences, and wildlife ecology and management. FRES, sometimes referred to as the Treehouse, is located on the fifth floor of West Wadsworth Hall.

First Year Experience (FYE)—FYE is a living option for first-year students to build a solid foundation for their success at college. This is a lively community offering a variety of educational and social activities. It is located on the fifth floor of East Wadsworth Hall.

Healthy Living House (HLH)—HLH residents participate in a variety of sports and social activities, educational workshops, and a personal wellness plan to help achieve their goals. This dynamic community focuses on wellness of the mind, body, and spirit. It is located on the fifth floor of East McNair Hall.

International House (I-House)—I House offers students the opportunity to live with a student from another culture. Social programs allow students to share ideas and backgrounds in this multicultural learning community. I-House is located on the second floor of West McNair Hall.

Leadership Learning Community (LLC)—LLC is designed to offer a fun, dynamic environment that will help students learn more about leadership and put their skills into practice. This community is located on the third floor of Douglass Houghton Hall.

Visual and Performing Arts Learning Community (VPALC)—VPALC is a dynamic community that will allow students to explore, create, and grow in their passion for art, music, theater, audio engineering, or sound design. VPALC is located on the third floor of West Wadsworth Hall.
Dining Services—All residents must choose a meal plan. The Platinum, Gold, and Silver Meal Plans offer anytime-dining (unlimited access) during regular hours of operation. Platinum has $240 in Dining Dollars each semester, Gold has $120 in Dining Dollars each semester, and Silver has no Dining Dollars. Dining Dollars allow students to eat at other times or at campus retail locations other than residence dining halls.

Residence Life Staff—Residence hall professional staff live in each hall and maintain regular office hours. They provide information, guidance, and aid in dealing with academic or personal issues. Residents are encouraged to seek their assistance with any questions.

Michigan Tech Apartments www.housing.mtu.edu
The University maintains 348 one- and two-bedroom apartments at Daniell Heights. The apartments overlook campus and are convenient to both the campus and the Student Development Complex. Rates depend upon the type of contract and occupancy. All utilities, except for telephone, cable, and internet, are provided. Residents who sign up for local phone service receive domestic long-distance service free. Every apartment is furnished, including an electric stove and refrigerator. Each building of six to eight apartments shares a free washer and dryer.

Picnic tables and children's play areas are located throughout the apartment area. Other amenities include a basketball court, sand volleyball court, high-speed computer access, an activity room, bike storage, and free bus service from the apartments to and from the main campus during the regular academic year.

Off-Campus Housing www.aux.mtu.edu/usghousing/
Many students choose to continue to live in residence halls beyond their first year, while others elect to live off campus in apartments, homes, or with Greek organizations. In order to assist those students interested in locating off-campus housing, Undergraduate Student Government (USG) maintains a list of off-campus householders renting to students, available from the USG Office, room 106, Memorial Union Building.

Support Services

Career Center www.career.mtu.edu
The University Career Center is designed to meet the career planning, preparation, and placement needs of all undergraduate and graduate students and alumni of Michigan Tech. Services include seminars, a one-credit career development course, career fairs, a career resource center, individual advising, resume writing and critiquing, mock interviewing, on-campus interviewing, corporate speakers, and a career guidance software program. All services are free to Michigan Tech students and alumni.

Students are encouraged to visit the Career Center early in their academic career. By participating in co-op or summer internship work experience, learning interview skills, and being introduced to the corporate world, students will be well prepared for permanent employment upon graduation.

Students are also encouraged to attend semiannual on-campus job fairs sponsored by Michigan Tech. Job fairs are one of the most effective opportunities for students to obtain co-op, summer internship, and permanent employment positions.

Visit the Career Center's website at www.career.mtu.edu for a complete description of the numerous services and benefits that are available.

Child Care http://www.mtu.edu/childcare/index.htm
The newly opened Little Huskies Child Development Center, located on campus between the SDC tennis courts and the Forestry Complex on MacInnes Drive, encourages and supports the growth and development of young children, from infants to kindergartners, in a caring and nurturing environment. The center helps to attract and support world-class faculty, staff, and students. The center is one of the many people-focused work/life initiatives intended to provide an outstanding educational and work environment for Michigan Tech students, faculty, and staff.

The Little Huskies Child Development Center gives priority to children whose parents or legal guardians are students or employees of Michigan Tech, although children from the community are welcome and may be admitted at an increased tuition rate. For more information, please contact center director Eva-Marie Hatfield at 906-487-3528.
Counseling and Wellness Services provides student-centered services and programs. Our goal is to help students deal with life's everyday challenges and problems by giving professional support. We also offer various wellness programs that focus on helping students create a healthier lifestyle and positive self-image.

Counseling and Wellness Services provides personal and academic counseling. Students may meet individually with a counselor to address any concerns or problems they have, including depression, anxiety and stress, adjustment to college, eating disorders, date rape, pregnancy, relationship or family problems, sexuality, self-esteem, substance abuse, or others. Counselors can also assist students in improving time management and study skills and interpersonal communication skills.

Additionally, Counseling and Wellness Services offers group counseling. Small groups of students may meet to discuss and deal with issues such as eating disorders; grief; substance abuse; recovering from rape, sexual assault, and sexual harassment; or any other area of need.

Counseling and Wellness Services also offers wellness education resources. HOWL (Healthy Options for a Wellness Lifestyle) students provide workshops, presentations, and programming related to several health and wellness topics. Any group of students on campus can request a presentation or workshop in any area of interest. Just contact us and let us know what you are looking for.

Counseling and Wellness Services is located in the Hamar House—the white house next to Fisher Hall. All services are confidential and free of charge for students. To make an appointment, call 487-2538 during regular business hours. To request a workshop or presentation, call 487-2538 or email wellness@mtu.edu.

International Programs and Services (IPS) provides information and services to students interested and involved in study-abroad opportunities. IPS identifies foreign partner institutions and facilitates the development of student, faculty, and research international exchange agreements. In addition, the IPS serves as a home away from home for over eight hundred international students at Michigan Tech and provides visa and immigration counseling, advocacy and support services. Immigration and support services to international scholars on J-1 visa are also offered. IPS significantly contributes to the internationalization of Michigan Tech and Upper Peninsula communities by offering multiple cultural and educational programs. These include Intercultural Mentorship Program, Parade of Nations, International Ambassador Program, New International Student Orientation and informational workshops. IPS also offers intercultural communication training for the campus community.

Educational Opportunity (EdOpp) provides academic, professional, and personal educational opportunities for students. Partnerships with industry, community colleges, and secondary schools provide resources for many of our programs. The EdOpp Youth Programs, ExSEL Programs, and Outreach and MultiEthnic Programs support the recruitment and retention of a diverse student body. The department programs primarily focus on topics that address the needs of precollege, female, minority, and other underrepresented students. EdOpp also coordinates campus and community multicultural activities, Elderhostels, National Student Exchange, and other lifelong learning programs. EdOpp is the focal point for diversity and precollege information and assistance.

Michigan Tech is active in the following organizations through the EdOpp Department:

- AISES—American Indian Science and Engineering Society
- CSRDE—Center for Institutional Data Exchange and Analysis
- GEM—National Consortium for Graduate Degrees for Minorities in Engineering and Sciences Inc.
- MentorNet—E-mentoring Network for Diversity in Engineering and Sciences
- MSGC—Michigan Space Grant Consortium
- NSBE—National Society of Black Engineers
- SHPE—Society of Hispanic Professional Engineers
- NSE—National Student Exchange
Information Technology (IT)  www.oit.mtu.edu
Information Technology provides the foundation for Michigan Tech's computing environment and manages the network, data, telephone, video, applications, and systems infrastructure needed to support the University's education, research, and community service missions. Specific academic computing resources are offered by individual schools and college departments.

Student Affairs Office  www.studentaffairs.mtu.edu
Student Affairs Office provides support to students in cocurricular and extracurricular areas, enriching and supporting the academic experience of students. Its goal is to create the best possible environment for the professional and personal growth and development of students. The student affairs staff also helps students resolve issues and problems.

Cultural and Educational Resources

Library  www.lib.mtu.edu
Library contains more than 800,000 volumes and regularly receives approximately 10,000 serials and periodicals. It is a designated depository for US government documents. The library archives maintain a collection of original materials concerning the history of the Keweenaw region, including the records of various copper mining companies.

A.E. Seaman Mineral Museum  www.museum.mtu.edu
A.E. Seaman Mineral Museum is one of North America’s great mineral museums and The Mineral Museum of Michigan. The world’s finest collection of Keweenaw Copper District minerals, Lake Superior Iron District minerals, and Michigan Basin minerals are on exhibit together with a comprehensive suite of gems, minerals, and meteorites from around the world. Come explore and enjoy nature’s mineral masterpieces. The museum is located on the fifth floor of the Electrical Energy Resources Center (EERC). Free admission; donations appreciated. Open all year, Monday through Friday, 9:00 AM to 4:30 PM. Also open Saturdays and Sundays, July through September, noon to 4:30 PM.
General Education

General Education Goals

General education goals, a required part of every Michigan Tech degree, include developing in each student

- fundamental scholarly habits of careful reading, communication, critical reasoning, balance, analysis, and argument.
- the ability to apply multiple disciplinary perspectives in interpretation, analysis, and creative problem solving.
- respect for diversity and awareness of complex contexts of their study and their work.
- knowledge of a broad range of topics and disciplines complementary to the major.

The General Education curriculum is made up of the following requirements:

- Four core courses (13 credits)
- Humanities, Arts, and Social Sciences (HASS) requirement (15 credits)
- Science, Technology, Engineering and Math (STEM) requirement (16 credits)
- Cocurricular activities (3 semester units, typically 6 half-credit classes)

General Education requirements are not normally waived, substituted, or modified. Advisors may submit specific requests in special situations, such as when students have received incorrect advice. Requests are reviewed on an individual basis by the Office of the Provost for the General Education Council.

Core Courses (13 credits)

The core courses are designed to promote active engagement in learning, coherence within the curriculum, integration within and across academic disciplines, development of strong communication skills, and development of university-level abilities. The core consists of the following:

- Perspectives on Inquiry (UN 1001, 3 credits)—an interdisciplinary, writing-intensive seminar taken in the first semester of the first year.
- World Cultures (UN 1002, 4 credits)—an interdisciplinary lecture/ lab course that focuses on globalization and human diversity. It is taken in the second semester of the first year. Two semesters of a single modern language along with UN 1003 World Cultures Activities may substitute for UN 1002—see Modern Language Option for World Cultures below.
- Revisions (UN 2001, 3 credits)—a writing and communications course taken during the sophomore year.
- Institutions (UN 2002, 3 credits)—an interdisciplinary course on human social, political and economic institutions taken fall during the sophomore year.

The core courses are designed to be taken according to the above schedule and are restricted to enrollment by the class year. Some core courses also have previous core courses as prerequisites. Students who do not take these courses on schedule risk being unprepared to complete general education requirements and may face graduation delays.

Modern Language Option for World Cultures (UN 1002)

Two semesters of a single modern language taken at Michigan Tech, along with UN 1003 World Cultures Activities, may substitute for UN 1002. Two semesters of language and UN 1003 satisfy the requirement for UN 1002 and 3 credit hours of HASS distribution requirements. Note the following:

- Students may begin their two semesters of modern language in the fall or spring semesters of their first year.
- Students choosing this option must enroll concurrently in UN 1003 World Cultures Activities and a modern language.
- Students with transfer or AP credit, or who plan to study abroad, should see the Humanities Department modern language director for advice.
Transfer Credit for Core Courses

1. After enrollment at Michigan Tech, a student may not transfer credits to meet UN 1001 and UN 1002.
2. Students may transfer credits to satisfy the Revisions (UN 2001) and Institutions (UN 2002) requirements even after enrollment at Michigan Tech, but they must see the Transfer Services Office to verify they are taking the correct course.
**Humanities, Arts, and Social Sciences (HASS) Distribution List**

**2009 – 2010 Academic Year**

For students entering Fall 2008 or later

Students must take 15 credits from the Humanities, Arts, and Social Sciences (HASS) Distribution List with the following limitations:

- No more than 3 credits from the HASS Creative Endeavors list may be used to satisfy the HASS Distribution List requirements.
- No more than 3 credits from the HASS Supplemental list may be used to satisfy the HASS Distribution List requirements.

**International Study Abroad for Distribution 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-University courses to distribution based on their being equivalent or congruent with existing general education distribution courses.

Courses marked with an asterisk may be taken during a student’s first year.

**HASS Distribution List**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
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<tbody>
<tr>
<td>BA4790</td>
<td>Ecology and Organizations</td>
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<tr>
<td>BL3970</td>
<td>Current Health Issues</td>
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<td>EC2001</td>
<td>Principles of Economics</td>
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<td>EC3002</td>
<td>Microeconomic Theory</td>
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<td>EC3030</td>
<td>Game Theory/Strategic Behavior</td>
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<td>International Economics</td>
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<td>EC3300</td>
<td>Industrial Organization</td>
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<td>EC3400</td>
<td>Economic Decision Analysis</td>
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<td>EC3700</td>
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No more than 3 credits from the HASS Creative Endeavors list may be used to satisfy the HASS Distribution List requirements.

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<td>FA2610</td>
<td>Acting II: Scene Study</td>
<td>3</td>
</tr>
<tr>
<td>FA3150</td>
<td>Life Drawing</td>
<td>3</td>
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<tr>
<td>FA3200</td>
<td>Watermedia II</td>
<td>3</td>
</tr>
<tr>
<td>FA3305</td>
<td>Ceramics II</td>
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<tr>
<td>FA3333</td>
<td>Sculpture*</td>
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</tr>
<tr>
<td>FA3335</td>
<td>Sculpture II</td>
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<tr>
<td>FA3400</td>
<td>Keweenaw Symphony Orchestra*</td>
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<tr>
<td>FA3401</td>
<td>Wind Symphony*</td>
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<tr>
<td>FA3430</td>
<td>Jazz Lab Band*</td>
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</tr>
<tr>
<td>FA3510</td>
<td>Concert Choir*</td>
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</tr>
<tr>
<td>HU2631</td>
<td>Fundamentals of Photography*</td>
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<td>HU2632</td>
<td>Fundamentals of Digital Photography*</td>
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<tr>
<td>SS3210</td>
<td>Field Archaeology</td>
<td>var</td>
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</table>

**HASS Supplemental List**

No more than 3 credits from the HASS Supplemental list may be used to satisfy the HASS Distribution List requirements.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>AF2001</td>
<td>History US Air/Space Power I</td>
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</tr>
<tr>
<td>AF2002</td>
<td>History US Air/Space Power II</td>
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<tr>
<td>AF3001</td>
<td>Leadership Studies I</td>
<td>3</td>
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<tr>
<td>AF4001</td>
<td>National Security Affairs I</td>
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<tr>
<td>AR4001</td>
<td>Developing Adaptive Leaders</td>
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<tr>
<td>BA3580</td>
<td>Legal Environment of Business</td>
<td>3</td>
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<tr>
<td>BA/SS3650</td>
<td>Intellectual Property Law, Technology, Society and Innovation</td>
<td>3</td>
</tr>
<tr>
<td>BA3710</td>
<td>Leadership Development</td>
<td>3</td>
</tr>
<tr>
<td>CM3410</td>
<td>Technical Communication for Chemical Engineering</td>
<td>3</td>
</tr>
<tr>
<td>ED3510</td>
<td>Communicating Science I</td>
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<tr>
<td>ED3511</td>
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<tr>
<td>ENT2961</td>
<td>Teaming in the Enterprise</td>
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<tr>
<td>ENT2962</td>
<td>Communication Contexts</td>
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<tr>
<td>ENT3958</td>
<td>Ethics in Engineering Design and Implementation</td>
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<tr>
<td>ENT3961</td>
<td>Enterprise Strategic Leadership</td>
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<tr>
<td>ENT3962</td>
<td>Communication Strategies</td>
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<tr>
<td>ENT4952</td>
<td>Complex Communication Practices</td>
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<td>FA2080</td>
<td>Presentation Skills*</td>
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</tr>
<tr>
<td>FA2830</td>
<td>Voice and Articulation*</td>
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<tr>
<td>GE2100</td>
<td>Environmental Geology*</td>
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<tr>
<td>HU2630</td>
<td>Introduction to Speech Communication*</td>
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<tr>
<td>HU3120</td>
<td>Technical and Scientific Communication</td>
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<tr>
<td>PSY3500</td>
<td>Human Robot Interaction</td>
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<tr>
<td>PSY3700</td>
<td>Industrial Organizational Psychology</td>
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<tr>
<td>PSY3850</td>
<td>Human Factors Psychology</td>
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<tr>
<td>SS3640</td>
<td>Selected Topics in Cyber-Law</td>
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<tr>
<td>UN2300</td>
<td>Global Technological Leadership</td>
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<tr>
<td>UN3401</td>
<td>Environmental Stewardship</td>
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</tr>
<tr>
<td>UN3405</td>
<td>Language Immersion</td>
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HASS Distribution List 2009-10, Page 59 of 167
Science, Technology, Engineering, and Mathematics (STEM) Courses
2009 – 2010 Academic Year

Students must take a minimum of 16 credits of Science, Technology, Engineering, and Mathematics (STEM) with the following limitations:* 

- Students must complete one laboratory science course.
- Students must complete a minimum of 4 credit hours in mathematics at the 1000-level or higher
- At least 12 of the credits must be outside the student’s major field of study.

*Some programs specify all 16 credits; others do not. For example, a computer science course may be required for some departments, but not others. Students should check with their academic advisor for specific requirements.

Lab Science (1 course)

For curricula that do not specify the lab science requirement, students can meet the requirement by taking one of the following:

<table>
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<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
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<tr>
<td>BL1010</td>
<td>General Biology I</td>
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<tr>
<td>BL1020</td>
<td>General Biology II</td>
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<tr>
<td>BL1040</td>
<td>Principles of Biology</td>
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<tr>
<td>BL2011</td>
<td>Anatomy and Physiology Lab I</td>
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<tr>
<td>BL2160</td>
<td>Botany</td>
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<tr>
<td>BL2170</td>
<td>Zoology</td>
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<tr>
<td>BL3310</td>
<td>Environmental Microbiology</td>
<td>3</td>
</tr>
<tr>
<td>BL3400</td>
<td>Principles of Ecology</td>
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<tr>
<td>BL4130</td>
<td>Phycology</td>
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<tr>
<td>BL4440</td>
<td>Fish Biology</td>
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<tr>
<td>BL4740</td>
<td>Introduction to Mycology</td>
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<tr>
<td>BL4810</td>
<td>Plant Taxonomy</td>
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<tr>
<td>CH1112</td>
<td>University Chemistry Lab I</td>
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<tr>
<td>CH1112</td>
<td>University Chemistry–Studio Lab I</td>
<td>5</td>
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<tr>
<td>CH1122</td>
<td>University Chemistry–Studio Lab II</td>
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<td>CH1161</td>
<td>University Chemistry Lab II</td>
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<tr>
<td>EH3700</td>
<td>Lifetime Fitness</td>
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<tr>
<td>FW1035</td>
<td>Wood Anatomy and Properties</td>
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<tr>
<td>FW2010</td>
<td>Vegetation of North America</td>
<td>4</td>
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<tr>
<td>FW3330</td>
<td>Soil Science</td>
<td>4</td>
</tr>
<tr>
<td>FW3610</td>
<td>Ornithology</td>
<td>4</td>
</tr>
<tr>
<td>FW4220</td>
<td>Wetlands</td>
<td>4</td>
</tr>
<tr>
<td>FW4240</td>
<td>Mammalogy</td>
<td>4</td>
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<tr>
<td>GE2000</td>
<td>Understanding the Earth</td>
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</tr>
<tr>
<td>GE2300</td>
<td>Earth Materials I: Mineralogy</td>
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</tr>
<tr>
<td>GE2500</td>
<td>Introduction to Oceanography</td>
<td>3</td>
</tr>
<tr>
<td>GE3320</td>
<td>Earth History and Paleoclimatology</td>
<td>3</td>
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<tr>
<td>GE3850</td>
<td>Geohydrology</td>
<td>3</td>
</tr>
<tr>
<td>GE4100</td>
<td>Geomorphology and Glacial Geology</td>
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<tr>
<td>GE4150</td>
<td>Natural Hazards</td>
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<tr>
<td>PH1100</td>
<td>Physics by Inquiry I (plus PH2100)</td>
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<tr>
<td>PH1111</td>
<td>College Physics I Laboratory (plus PH1110)</td>
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<td>PH1141</td>
<td>Applied College Physics I Laboratory (plus PH1140)</td>
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<tr>
<td>PH1161</td>
<td>Introduction to Experimental Physics I (plus PH1160)</td>
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<tr>
<td>PH1200</td>
<td>Physics by Inquiry II (plus PH2200 or PH1210 or PH1240)</td>
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<tr>
<td>PH1610</td>
<td>Introductory Astronomy Laboratory (plus PH1600)</td>
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<tr>
<td>SS3220</td>
<td>Archaeological Sciences</td>
<td>4</td>
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</tbody>
</table>

Mathematics (4 credits)

For curricula that do not specify the mathematics requirement, students can meet the requirement by taking one of the following:

- 4 credits or more of any Mathematics (MA) course, 1000-level or higher, except MA4945.

Other STEM Courses

For curricula that do not specify the remaining STEM requirement, students can meet the requirement by taking the following:

- Any course listed under the lab science requirement that is not being used to satisfy the lab science requirement
- BA2110, Quantitative Problem Solving
- Biology (BL): any course 1000-level or higher, except BL3970**
- BE2500, Introduction to Biostatistics
- Chemistry (CH): any course, 1000-level or higher
- Computer Science (CS): any course, 1000-level or higher
- EC4200, Econometrics
- EH1500, Foundations of Kinesiology
- EH2200, Human Reproductive Health and Development
- Engineering (BE, CE, CM, EE, ENG, GE, MEEM, MY, SSE): any course, 1000-level or higher
- Forestry (FW): any course, 1000-level or higher, except FW3110 and FW3760**
- Geology (GE): any course, 1000-level or higher, except GE2100, GE2900 and GE4630**
- Mathematics (MA): any course, 1000-level or higher, that is not being used to satisfy the 4-credit mathematics requirement except MA4945**
- Physics (PH): any course, 1000-level or higher
- PSY2720, Statistics for Social and Behavioral Sciences
- PSY3060, Physiological Psychology
- SS3220, Archaeological Sciences
- Technology (CMG, EET, MET, SAT, SU, TE): any course, 1000-level or higher

**These courses may not be used to satisfy STEM requirements because they are included on the HASS list.
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 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 co-curricular activity will count toward satisfactory progress for financial aid purposes and toward status as a full-time student.

### Co-curricular Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td>PE0168</td>
<td>Beginning Pilates</td>
<td>.5</td>
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<tr>
<td>PE0169</td>
<td>Spinning</td>
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</tr>
<tr>
<td>PE0170</td>
<td>Beginning TaeKwonDo and Hapkido</td>
<td>.5</td>
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<tr>
<td>PE0173</td>
<td>Fall Outdoor Adventures</td>
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<tr>
<td>PE0174</td>
<td>Winter Outdoor Adventures</td>
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<tr>
<td>PE0175</td>
<td>Hiking</td>
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<tr>
<td>PE0200</td>
<td>Wellness and A Sustainable Lifestyle</td>
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<tr>
<td>PE0205</td>
<td>Intermediate Bowling</td>
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<tr>
<td>PE0206</td>
<td>Intermediate Golf</td>
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<tr>
<td>PE0210*</td>
<td>Special Topics in Physical Education</td>
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<tr>
<td>PE0215</td>
<td>Intermediate Swimming</td>
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<tr>
<td>PE0216</td>
<td>Intermediate Basketball</td>
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<tr>
<td>PE0217</td>
<td>Intermediate Hockey</td>
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<tr>
<td>PE0218</td>
<td>Intermediate Weight Training</td>
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<tr>
<td>PE0220</td>
<td>Intermediate Alpine Skiing (Downhill)</td>
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<tr>
<td>PE0221</td>
<td>Intermediate Snowboarding</td>
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<tr>
<td>PE0222</td>
<td>Alpine Ski Racing</td>
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<td>PE0223</td>
<td>Freestyle Alpine Skiing</td>
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<td>PE0224</td>
<td>Snowboard Racing (Bordercross)</td>
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<td>PE0225</td>
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<td>PE0226</td>
<td>Intermediate Volleyball</td>
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<tr>
<td>PE0227</td>
<td>Intermediate Archery</td>
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<tr>
<td>PE0230</td>
<td>Water Polo</td>
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<tr>
<td>PE0232</td>
<td>Intermediate Soccer</td>
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<tr>
<td>PE0235</td>
<td>Intermediate Cross Country Skiing</td>
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<tr>
<td>PE0238</td>
<td>Intermediate Racquetball/Squash</td>
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<tr>
<td>PE0239</td>
<td>Intermediate Badminton</td>
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<tr>
<td>PE0240</td>
<td>Intermediate Tennis</td>
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<tr>
<td>PE0246</td>
<td>Intermediate Billiards</td>
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<td>PE0248</td>
<td>Intermediate Skating</td>
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<tr>
<td>PE0252</td>
<td>Intermediate Social Dance</td>
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<tr>
<td>PE0253</td>
<td>Intermediate Aerobics</td>
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<td>PE0256</td>
<td>Intermediate Mountain Biking</td>
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<td>PE0266</td>
<td>Running for Fitness</td>
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<td>PE0267</td>
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<td>PE0268</td>
<td>Intermediate Pilates</td>
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<tr>
<td>PE0270</td>
<td>Intermediate TaeKwonDo and Hapkido</td>
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<tr>
<td>PE0301</td>
<td>Military Marksmanship</td>
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<td>PE0306</td>
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<td>PE0320</td>
<td>Advanced Skiing</td>
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<td>PE0321</td>
<td>Advanced Snowboarding</td>
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<td>PE0340</td>
<td>Advanced Tennis</td>
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<td>PE0355</td>
<td>Advanced Road Biking</td>
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<tr>
<td>PE0420</td>
<td>Ski Instructor Training</td>
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<td>PE0421</td>
<td>Snowboard Instructor Training</td>
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<td>PE1470</td>
<td>Lifeguard Swimming</td>
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<td>PE1580</td>
<td>Water Safety Skills</td>
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<tr>
<td>PE2010</td>
<td>Varsity Football</td>
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<td>PE2020</td>
<td>Varsity Basketball</td>
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<td>PE2028</td>
<td>Ski Patrol (Hill)</td>
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<td>Varsity Hockey</td>
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<td>PE2040</td>
<td>Varsity Nordic Skiing</td>
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<td>PE2080</td>
<td>Varsity Track</td>
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<td>PE2090</td>
<td>Varsity Tennis</td>
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<td>PE2130</td>
<td>Varsity Volleyball</td>
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<td>PE2140</td>
<td>Varsity Cross Country</td>
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<td>PE2150</td>
<td>Cross Training</td>
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<td>PE2230</td>
<td>Cheerleading Dance Team</td>
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<tr>
<td>PE2240</td>
<td>Cheer Team</td>
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</tbody>
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*PE0210 may be used more than once for general education co-curricular credit if topics are different.*
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. Offered the first and last half of fall and spring
semesters. May be used once as a general education co-curricular course.
Sports physical required prior to start of class (contact instructor for details).
Credits: 0.5; Repeatable to a Max of 1; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, 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; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: On Demand
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. Offered first and second half of fall and spring semesters. 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; Repeatable to a Max of 1; 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, officerhip, professionalism, military customs and courtesies,
officer opportunities, and communication skills. Leadership Laboratory is
mandatory for AFROTC cadets and complements this course by providing
opportunities, officership, professionalism, and communication skills. The course includes
hands-on practice of basic military skills, including basic first-aid, weapons
familiarization, orienteering, individual and squad level tactics, techniques and
procedures.
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, officerhip, 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: Fall

AF 1300 - Basic Aeronautics
Examines aircraft systems and instrumentation, aerodynamics, aircraft
performance, VFR cross-country navigation techniques, and weather reports
and forecasts. Includes the Federal Aviation Regulations and aviation
physiology. At the end of this course, students will have received the
aeronautical knowledge necessary for certification as a private pilot.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: On Demand
Restrictions: Permission of instructor required

AF 2001 - History 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 - History 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 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: (0-3-1)
Semesters Offered: Spring
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
officerhip, team building, feedback, Air Force evaluation systems, leadership
ethics, professional relations, and communication skills. The course includes
discussion, informal lecture, case studies, and experiential exercises.
Credits: 3.0
Lec-Rec-Lab: (0-3-1)
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, and joint doctrine.
Credits: 3.0
Lec-Rec-Lab: (0-3-1)
Semesters Offered: Spring
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 officerhip.
Credits: 3.0
Lec-Rec-Lab: (0-3-1)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

AR 1001 - Foundations in Officerhip
Introduction to the challenges and competencies that are critical for effective
leaderhip. Students learn how the personal development of "life skills" such as
goal setting, stress management, physical fitness and time management
relate to leadership, officerhip, and the Army profession.
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall

AR 1003 - Basic Leadership
Overview of leadership fundamentals: problem solving, goal setting, listening
skills, providing feedback and effective oral and written communication.
Students explore dimensions of leadership values, attributes, skills, and
actions in the context of practical hands-on interactive exercises.
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall

AR 1011 - Basic Leadership Lab I
Hands-on practice of basic military skills, including basic first-aid, weapons
familiarization, orienteering, individual and squad level tactics, techniques and
procedures.
Credits: 1.0
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall
AR 1012 - Basic Leadership Lab II
Hands-on practice of basic military skills, including basic first-aid, cold weather survival skills, weapons familiarization, orienteering, snowshoeing, individual and squad level tactics, techniques and procedures.
Credits: 1.0
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Spring

AR 2001 - Individ. Leadership Studies I
Explores the dimensions of creative tactical leadership using historical case studies and interactive exercises. Students practice aspects of personal motivation and team building in various situations and environments. Students are introduced to creative problem solving techniques and procedures.
Credits: 1.0
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall

AR 2002 - Individ. Leadership Studies II
Examines the challenges of leading in complex operational environments. Cross-cultural leadership challenges in a changing world are highlighted and applied to practical leadership tasks and situations. Students develop greater self awareness as they hone their communication and team building skills.
Credits: 1.0
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Spring

AR 2011 - Intermediate Leadership Lab I
Hands-on practice of basic military skills, including leadership of a fire team, basic first-aid, weapons familiarization, orienteering, and individual level tactics, techniques and procedures.
Credits: 1.0
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall

AR 2012 - Intermediate Leadership Lab II
Hands-on practice of basic military skills, including leadership of a fire team, basic first-aid, cold weather survival skills, weapons familiarization, orienteering, snowshoeing, individual and squad level tactics, techniques, and procedures.
Credits: 1.0
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Spring

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.
Credits: 1.0; Repeatable to a Max of 12; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Fall

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.
Credits: 1.0; Repeatable to a Max of 12; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Spring

AR 2075 - Ranger Challenge
The varsity sport of ROTC in which teams compete in leadership technical and tactical skills. The competition is to provide mental and physical challenges with goals of training excellence, discipline, and victory. May be used once as a general education co-curricular course. Prerequisite: enrollment in ROTC or permission from Army ROTC department.
Credits: 1.0; Repeatable to a Max of 4; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Spring

AR 3001 - Adaptive Team Leadership
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.
Credits: variable to 3.0
Semesters Offered: Fall
Co-Requisite(s): AR 3011

AR 3002 - Tactical Leadership
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.
Credits: variable to 3.0
Semesters Offered: Spring
Co-Requisite(s): AR 3012
Pre-Requisite(s): AR 3001

AR 3011 - Advanced Leadership Lab I
Hands-on practice of basic military skills, including squad and platoon leadership, basic first-aid, weapons familiarization, orienteering, and individual, squad and platoon level tactics, techniques and procedures.
Credits: 1.0
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall
Co-Requisite(s): AR 3001

AR 3012 - Advanced Leadership Lab II
Hands-on practice of basic military skills, including squad and platoon leadership, basic first-aid, weapons familiarization, orienteering, snowshoeing, cold weather survival skills, and individual, squad and platoon level tactics, techniques and procedures.
Credits: 1.0
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Spring
Co-Requisite(s): AR 3002
Pre-Requisite(s): AR 3011

AR 3014 - Airborne School
Three week course taught at the U.S. Army Airborne School teaches students the basic techniques of parachuting. Course is very physically and mentally demanding, requiring cadets to be in excellent physical condition to attend and successfully complete the course. May be used once as a general education co-curricular course.
Credits: 1.0; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Summer
Restrictions: Permission of department required
Pre-Requisite(s): AR 1001 or AR 1002

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.
Credits: 1.0; Repeatable to a Max of 12; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Fall
Restrictions: Permission of department required; May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): AR 2068 and AR 2069

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.
Credits: 1.0; Repeatable to a Max of 12; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Spring
Restrictions: Permission of department required; May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): AR 3068

AR 3100 - Special Topics Small Group Leadership
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
Pre-Requisite(s): AR 3100

AR 4001 - Developing Adaptive Leaders
Develops proficiency in planning, executing, and assessing operations while serving as a battalion staff officer. Prepares cadets for their first unit of assignment. Cadets identify responsibilities of their staff roles and use situational opportunities to teach, train and develop subordinates.
Credits: variable to 3.0
Semesters Offered: Fall, Spring
Co-Requisite(s): AR 4011
Pre-Requisite(s): AR 3001 and AR 3002

AR 4004 - Leadership in a Complex World
Cadets apply military law, principles of war, and rules of engagement to current operations. Interaction with non-government organizations, civilians, and other nations are explored. Case studies, scenarios, and exercises prepare cadets for service as commissioned officers in the US Army.
Credits: variable to 3.0
Semesters Offered: 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 cadet 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

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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 cadet 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 5100 - Atmospheric Sciences Research Discussion
Credits: 1.0; May be repeated
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): ATM 5515 or ATM 5640 or ATM 5680 or CE 5515 or PH 5640 or PH 5680

ATM 5200 - Special Topics in Atmospheric Sciences
Advanced study of topics in the atmospheric sciences. The subject matter may vary from term to term depending on the needs and interests of students.
Credits: variable to 3.0; Repeatable to a Max of 9
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

ATM 5512 - Applied Boundary Layer Meteorology
Study of how forcing phenomena affect transport of water and chemicals in the atmospheric boundary layer and how this transport is measured in the field, including relevant aspects of fluid dynamics, boundary layer structure, surface energy balance, and flux measurement.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Level(s): Graduate

ATM 5515 - 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 Level(s): Graduate
Pre-Requisite(s): CH 3520 or CE 4501

ATM 5640 - Atmospheric Physics
Essential elements of atmospheric physics, including thermodynamics (e.g. adiabatic processes, phase transformations, stratification), aerosol and cloud physics (e.g. nucleation, Kohler theory, growth by condensation and collection), and radiative transfer (e.g. Beer's law, transfer equations with and without scattering).
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2008-2009 academic year
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): MA 3530 and PH 2300

ATM 5680 - Atmospheric Fluid Dynamics
Fundamentals forces and conservation laws that govern fluid flow; applications to the atmosphere, including balanced flow (pressure gradient and Coriolis Force), vorticity dynamics, turbulence, waves, and boundary layers.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2007-2008 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior
Pre-Requisite(s): MA 3530 and PH 2300

ATM 6975 - Full-Time Doctoral Research
Open to students who have successfully completed all required courses as well as the comprehensive and proposal defense exams. Students in this course are involved in full-time research. Tuition for this course is charged at the graduate full-time research rate. Students enrolled in this course may not register for any other course.
Credits: 9.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-9-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

ATM 6999 - Doctoral Research
Independent research conducted in partial fulfillment of the requirements of the Atmospheric Sciences doctoral degree.
Credits: variable to 12.0; May be repeated; Graded Pass/Fail Only
Semesters Offered: On Demand
Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

Business

BA 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

BA 1200 - IS/IT Fundamentals
Covers basic concepts underlying information technology. Introduces systems concepts, information technology, application software, and programming using an industry standard programming language. Introduces information use in organizations and how information technology enables improvements in the quality and timeliness of information.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring, Summer

BA 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

BA 2110 - 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: (3-0-0)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): BA 2100(C) or MA 2710(C) or MA 2720(C) or MA 3710(C) or MA 3720(C)

BA 2200 - Business Programming Concepts
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
Pre-Requisite(s): BA 1200

BA 2210 - Web Application Development
Covers development technologies, tools, and environments of web-enabled and e-commerce business solutions. Topics include the nature of the development environment for web-based solutions, fundamentals of development technologies, desirable development practices, and design, 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): BA 2200 or CS 1121 or CS 1131
BA 2330 - Accounting I
Basic introduction to the principles, concepts, theories and practices underlying financial reporting; an introduction to managerial accounting concepts, theories and practices including product and service costing, budgeting, capital investments and the uses of accounting information for planning and controlling operations.
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

BA 2340 - Accounting II
Examination of principles, concepts and theories underlying the valuation of financial statement elements and the examination of managerial accounting concepts, theories and practices routinely used to support decision making within organizations.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring, Summer

BA 2500 - Business Law I
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

BA 2700 - Business Problem Solving
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

BA 2920 - IS/IT Topics
Examines current IS/IT topics and issues in greater depth from a managerial perspective. A single offering of this course will concentrate on one or two topics, which will vary.
Credits: 3.0; Repeatable to a Max of 6
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Pre-Requisite(s): BA 3200

BA 3290 - Accounting Theory/Practice I
Studies the theory, concepts, and practices underlying financial reporting 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
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): BA 2310 or BA 2340

BA 3310 - Accounting Theory/Practice II
A continuation of BA3300 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
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): BA 3300 and BA 3400(C)

BA 3320 - 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
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): BA 2310 or BA 2340

BA 3400 - Principles of Finance
Introduction to the principles of finance. Topics include financial mathematics, capital acquisition, the capital investment decision, financial assets valuation, and working capital management
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): (BA 2100 or MA 2710 or MA 2720 or MA 3710) and BA 2340

BA 3580 - Legal Environment of Business
Provides an understanding of business structures, the regulatory environment of business, and the constitutional protections of property and conduct.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring, Summer

BA 3600 - Quality Management
Current quality control and management philosophy, concepts, and tools: strategic importance, philosophies of leading sages, practices (including ISO9000 standards and Baldrige award requirements), process-focused and result-focused tools as well as statistical process control.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: On Demand
Pre-Requisite(s): BA 2100 or MA 2710 or MA 2720 or MA 3710

BA 3610 - Operations Management
Fundamental principles of operations and service 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, capacity management, and maintenance management.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): BA 2110
BA 3620 - 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): BA 2100 or MA 2710 or MA 2720 or MA 3710 or EET 2010

BA 3650 - Intellectual Property Law, Technology, Society and Innovation
Principles of intellectual property law, addressing legal and contemporary policy issues in copyright, trademark and patent and how the law impacts the balance between property protections, technological innovation and public access. Emphasizes learning through lectures, case studies, and simulations.
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

BA 3700 - 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, Sophomore

BA 3710 - 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: (0-3-0)
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, Sophomore

BA 3780 - Entrepreneurship
Covers management issues associated with establishing a successful new enterprises as a small businesses or part of an existing firm. Create a business plan. Case studies develop 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, Summer
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

BA 3800 - 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, Sophomore

BA 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

BA 4210 - Advanced Information Systems
Focuses on understanding IT for competitive advantage and as an agent of transformation. Topics include managing IT infrastructure and architecture, facilitating information distribution throughout the enterprise, conducting case analyses to develop a framework for innovative Enterprise Systems to be used for sustainable competitive advantage.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring - Offered alternate years beginning with the 2010-2011 academic year
Restrictions: Must be enrolled in one of the following Class(es): Senior
Pre-Requisite(s): BA 3210 and BA 3220

BA 4250 - Information Systems Projects
MIS capstone course. Previous completion of MIS electives and BSBA technology corequisite required. Applies IS concepts as solutions to business problems using project teams and faculty project manager supervision. Emphasizes the latter portion of the systems development life cycle project management within an IS context.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Class(es): Senior
Pre-Requisite(s): BA 2200 or CS 1121 or CS 1131 or ENG 1101 or ENG 1100 or SAT 1200 and BA 3210 and BA 3220

BA 4300 - Attestation and Assurance
Auditing procedures and techniques associated with public accounting and with internal auditing for business entities. Topics include auditor's responsibilities, professional ethics, generally accepted auditing standards, purpose and types of audits, objectives, internal control, evidence, organization within the public accounting profession, the audit program, and auditing procedures and techniques.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Class(es): Senior
Pre-Requisite(s): BA 3310(C) and BA 3300

BA 4310 - 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
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): BA 2310 or BA 2340

BA 4320 - 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
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): BA 3320

BA 4350 - Advanced Tax Topics
Continuation of BA4310. 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, gratuities transfers, multi-jurisdictional operations, and entity formations, liquidations, and reorganizations.
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): BA 4310

BA 4360 - 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, Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): BA 2310 or BA 2340

BA 4370 - Advanced and Governmental Accounting
Advanced measurement and financial reporting problems encountered by accountants. Topics include the Statement of Cash Flows, consolidations and mergers, partnerships, governmental and not-for-profit organizations, and foreign operations.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): BA 2310 or BA 2340

BA 4370 - Advanced and Governmental Accounting
Advanced measurement and financial reporting problems encountered by accountants. Topics include the Statement of Cash Flows, consolidations and mergers, partnerships, governmental and not-for-profit organizations, and foreign operations.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): BA 2310 or BA 2340
BA 4400 - Investment Analysis
Operations of the stock market, bond market, and other financial markets. Stock and bond valuation techniques, financial markets and institutions, and investment opportunities.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): BA 3400 or EC 3400

BA 4410 - Advanced Financial Management
Advanced topics in managerial finance: working capital management, capital budgeting, investment analysis, portfolio theory, and other topics. Includes case studies, class discussion, use of the computer in financial modeling, and other financial applications.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): BA 3400

BA 4450 - Special Topics in Finance
Examines current issues in Finance and other topics of interest to faculty and students in greater depth.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: On Demand
Restrictions: Permission of instructor required
Pre-Requisite(s): BA 3400 or EC 3400

BA 4460 - 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
Pre-Requisite(s): BA 3400

BA 4470 - Applied Portfolio Management
Covers issues in the management and administration of investments in an institutional setting. Students manage a real portfolio of financial assets.
Credits: variable to 3.0; Repeatable to a Max of 6
Semesters Offered: Fall, Spring
Restrictions: Permission of instructor required; May not be enrolled in one of the following Class(es): Freshman, Sophomore

BA 4480 - 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: Spring - Offered alternate years beginning with the 2001-2002 academic year
Pre-Requisite(s): BA 3400

BA 4490 - Personal Financial Planning
Provides students with an overview of personal financial issues and services and instruments offered by economic and financial institutions. Topics include the personal financial environment, employee compensation, personal investments and asset management, tax planning, the development of an adequate but cost-effective insurance program, and retirement planning
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): BA 3400 or EC 3400

BA 4600 - Management of Technology and Innovation
An evolutionary process perspective will be taken viewing how technology strategy evolves from underlying technology competences and capabilities, understanding patterns of technological innovations, development of technological capabilities and competences, the role of collaboration in innovation, and profiling from new technologies.
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
Pre-Requisite(s): BA 3400

BA 4620 - Supply Chain Management
Designing and managing channels of distribution, purchase and movement of goods, and transportation systems. Emphasizes design of appropriate marketing channels, advanced topics in inventory control, facility location, routing of physical flows among facilities, and design and evaluation of transportation systems
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): BA 2110 and BA 3610 and BA 3800

BA 4630 - 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): BA 3610

BA 4680 - International Technology Management
Comparative international studies of economic and managerial aspects of technological innovation. Analyzes conditions, forms, and structures of management for international technological projects. Case studies of international transfer of technology. Two credits without a research report; three credits with a research report.
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): BA 4600(C)

BA 4700 - Strategic Management
Introduction to strategy content (e.g., differentiation, diversification, and strategic alliances) and strategizing processes (e.g., decision-making and restructuring). The course emphasizes strategies and strategizing processes within technological firms.
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): BA 3200 and BA 3400 and BA 3610 and BA 3700 and BA 3800

BA 4710 - International Management
Study of managing work in a global context. Assesses impact of culture and the international environment (economic, social, legal, technological) on management, personnel, marketing, accounting, and finance strategies. Examines international business structures from licensing to joint ventures. Develops attitudes and skills leading to increased international effectiveness.
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, Junior
Pre-Requisite(s): BA 3700 and EC 3100(C)

BA 4740 - 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: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: On Demand
Restrictions: Permission of instructor required
Pre-Requisite(s): BA 3700

BA 4750 - Managing Change in Organizations
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: Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): BA 3700
BA 4790 - Ecological Sustainability and Organizations
Examines the problems and solutions associated with creating and maintaining ecologically sustainable organizations (primarily businesses). Builds an ethical framework using concepts of ecological identity and place and examines the principles of ecological economics and sustainable development.
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

BA 4900 - Research and Special 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

BA 4950 - CenTILE Project
Students work on a consulting oriented team project under the guidance of a faculty advisor. The team collaborates with a client to analyze a problem, develop a project plan, summarize findings, and make recommendations.
Credits: variable to 4.0; Repeatable to a Max of 6
Semesters Offered: On Demand
Restrictions: Permission of instructor required

BA 5200 - Information Systems
Focuses on management of IS/IT within the business environment. Topics include IT infrastructure and architecture, organizational impact of innovation, change management, and human-machine interaction. Class format includes lecture, discussion, and integrative case studies.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate

BA 5290 - Special Topics in IS/IT
IS/IT 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; Must be enrolled in one of the following Level(s): Graduate

BA 5300 - Accounting
This class covers the collection, reporting and analysis of financial information with emphasis on the use of that information to support decision making.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): BA 2330

BA 5390 - Special Topics in Accounting
Accounting 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; Must be enrolled in one of the following Level(s): Graduate

BA 5400 - Finance
Explores the theory and practice of finance and capital markets. Topics include role of the financial manager and goals of the firm, financial mathematics, valuation of assets, cost of capital, project evaluation, capital structure, forecasting, financing vehicles, special topics in finance.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): BA 3400 or EC 3400

BA 5410 - Finance II
Focuses on central issues in corporate finance, such as capital structure, dividend policy, lease versus buy, working capital management, mergers and acquisitions, risk management, financial engineering, pension fund management, and fixed-income securities.
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): BA 5400

BA 5460 - Derivative Securities
Studies futures, forwards, and option pricing and their uses for speculation, arbitrage and hedging. The option pricing framework is extended to cover exotic options and options embedded in real assets.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): BA 5400

BA 5490 - Special Topics in Finance
Finance 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; Must be enrolled in one of the following Level(s): Graduate

BA 5610 - Operations and Quality Management
Applications and case studies focusing on contemporary issues in operations and quality management to include lean manufacturing practices, ERP, quality and environmental management systems/standards, Six Sigma, statistical process control, and other current topics.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): BA 2110
BA 5630 - Operations Strategy
Application and case studies are used to address issues in operations management, quality, research and development, capacity planning, budgeting, marketing, supply chain, and technology to provide an interdisciplinary, quantitative focus on decision making and strategic planning for operations.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): BA 5610

BA 5640 - Global Operations and Supply Chain Management
Case analysis, in-depth article reviews, and course projects are used to address issues in the design and management of global supply chains. Topics include global sourcing strategies, strategic alliances, demand and supply uncertainties, logistic network design, managing variability and risk, supply chain interactions and the value of information.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring, Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): BA 5610

BA 5650 - Project Management
Focuses on project definition, selection, planning, scheduling, implementation, performance monitoring, evaluation and control. Emphasis will be on product, service and process development and emerging concepts related to development on the internet. Some advanced concepts in resource constraint management and design matrix are included.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): MA 2710 or MA 2720 or MA 3710

BA 5670 - Business Process Simulation
Discrete event and continuous simulation modeling techniques applied to the analysis of business processes. Special- purpose simulation software will be used to analyze cases and problems from the manufacturing and service sectors.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): MA 2710 or MA 2720 or MA 3710 or MA 3720

BA 5690 - Special Topics in Operations & Systems Management
Operations and systems management 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; Must be enrolled in one of the following Level(s): Graduate

BA 5700 - Management & Organizational Behavior
Discusses managing effectively within the environmental context of the organization. Topics include corporate culture, managing in a global environment, planning and strategy, organizational structure, human resources management, managing change, leadership, motivation, communication, conflict management, and teamwork.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate

BA 5710 - Business Strategy
Introduces students to a repertoire of strategies that have been found useful in the creation of competitive advantage: cost leadership, business model differentiation, vertical integration, diversification, globalization, mergers and acquisitions, tacit collusion, alliance, and flexibility-agility-adaptability strategies.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate

BA 5720 - Entrepreneurship I - Launching Entrepreneurial Ventures
Focuses on the development of new technology-based businesses. Topics include building an effective entrepreneurial team, ethics and social responsibility, financial planning/reporting, working capital management, growth marketing, product/process development, raising capital, managing change and development, and planning for succession.
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; May not be enrolled in one of the following Class(es): Junior, Senior

BA 5730 - Entrepreneurship II - Growing and Managing New Ventures
Focuses on growing new technology-based businesses. Topics include expansion, managing change and development, and planning for succession.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate

BA 5740 - Management of Technology and Innovation
An evolutionary strategic perspective is taken viewing how technology strategy evolves from underlying technological competencies, patterns of innovation, sources of external technological knowledge and modes of transfer.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

BA 5750 - Strategic Managerial Processes
Introduces students to advanced topics in strategic change, strategy formation, and strategy implementation through a review of organization theories and processes. Course materials are applied to specific projects through individual specialized strategic management research projects.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

BA 5760 - Corporate Social Responsibility & Business Ethics
Explores corporate social responsibility (CSR), business ethics, and corporate governance. Topics include organizational and environmental forces which drive CSR (e.g., sustainability, fair trade, globalization); stakeholder theory; the strategic context of CSR; and implementation of CSR into strategy and culture.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

BA 5790 - Special Topics in Management
Management 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; Must be enrolled in one of the following Level(s): Graduate

BA 5800 - Marketing
The course will provide an integrated approach to marketing management. Uses a modeling and case analysis approach to develop strategic marketing thinking.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate

BA 5890 - Special Topics in Marketing
Marketing 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; Must be enrolled in one of the following Level(s): Graduate

BA 5990 - Special Topics
Business topics of interest to students. Study is under the guidance of a faculty member.
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 Level(s): Graduate

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: Fall, Summer
Pre-Requisite(s): MA 1135 or MA 1160 or MA 1161

BE 2400 - Biology for Engineers I
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
Restrictions: May not be enrolled in one of the following Class(es): Senior

BE 2500 - Introduction to Biostatistics
Topics include collection of data, presentation of data, statistical inference, causality, basic probability, basic epidemiology, design of clinical trials, regulation in the health industry, and an overview of the health science research culture.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Class(es): Sophomore, Junior
Pre-Requisite(s): ENG 1102

BE 2600 - Introduction to Biomedical Engineering
Covers basic concepts of Biomedical Engineering including statistical distributions, physiological modeling, medical imaging, biomechanics, biomaterials, and biomedical instrumentation. It serves as the starting point for more advanced courses in biomedical engineering and to give students a broad yet quantitative overview of the field.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Class(es): Sophomore, Junior
Pre-Requisite(s): ENG 1102

BE 2650 - Biomedical Materials
An overview of biomaterials in three basic classes: metals, ceramics, and polymers. Topics include biomaterials used in special medical applications (such as tissue replacement, absorbable and non-absorbable sutures, and soft tissue replacements) as well as discussion of tissue, body, and blood response to implants (bio-compatibility).
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Major(s): Biomedical Engineering
Pre-Requisite(s): EE 3010 and BL 2020 and BL 2021 and BE 2600

BE 2660 - Biomedical Instrumentation
Introduction to theory of measurement and analysis from biological systems. Covers the use of transducers, data recording and analysis systems and signal processing techniques. Laboratory includes measurements of physiological quantities from living systems.
Credits: 4.0
Lec-Rec-Lab: (3-0-2)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Major(s): Biomedical Engineering
Pre-Requisite(s): EE 3010 and BL 2020 and BL 2021 and BE 2600

BE 3500 - Biomedical Materials
An overview of biomaterials in three basic classes: metals, ceramics, and polymers. Topics include biomaterials used in special medical applications (such as tissue replacement, absorbable and non-absorbable sutures, and soft tissue replacements) as well as discussion of tissue, body, and blood response to implants (bio-compatibility).
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Major(s): Biomedical Engineering
Pre-Requisite(s): BL 1040 or BE 2400 or BL 2400 and MY 2100 and (MEEM 2150(C) or ENG 2120(C)) and BE 2600

BE 3500 - Cell and Tissue Mechanics
Focuses on mechanical behavior and adaptation of musculoskeletal tissues including material properties, viscoelasticity, fatigue and failure. Includes the role of mechanical forces in the development, growth and adaptation of musculoskeletal tissues; cell biology and cellular mechanotransduction.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2009-2010 academic year
Pre-Requisite(s): BE 3500

BE 4100 - Cell and Tissue Mechanics
Focuses on mechanical behavior and adaptation of musculoskeletal tissues including material properties, viscoelasticity, fatigue and failure. Includes the role of mechanical forces in the development, growth and adaptation of musculoskeletal tissues; cell biology and cellular mechanotransduction.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2009-2010 academic year
Pre-Requisite(s): BE 3500

BE 4110 - Neuroengineering
Brief overview of neuroanatomy, neurophysiology, and neurobiology followed by introductions of more advanced topics including neural tissue engineering, neural/electrode interfaces, and functional electrical stimulation.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
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): BE 2400 and BE 3500

BE 4200 - Biology for Engineers 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: 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 2400

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 3500

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: 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 2020 or BE 2400

BE 4600 - Drug and Gene Delivery
Covers drug pharmacodynamics and pharmacokinetics. Provides a fundamental overview of the different drug delivery systems. Students will be introduced to polymers used to deliver therapeutics. Term project involves developing new technologies/therapeutics to treat diseases.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2009-2010 academic year
Pre-Requisite(s): BL 2020 or BE 2400

BE 4650 - Active Implantable Devices
Implantable devices that are actively delivering therapy and acting as monitoring tools will be covered. Emphasis will be on the technology and its application. Devices include electrical stimulators, pumps & diagnostic instrumentation.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2010-2011 academic year
Pre-Requisite(s): BE 3500

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
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: Spring - Offered alternate years beginning with the 2010-2011 academic year
Pre-Requisite(s): BE 3600

BE 4800 - 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: 1.0
Lec-Rec-Lab: (1-0-0)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior
Pre-Requisite(s): BE 4900

BE 4910 - 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
Co-Requisite(s): BE 4900
Pre-Requisite(s): BE 3500(C) and BE 3600 and BE 3750

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: 3.0
Lec-Rec-Lab: (0-1-6)
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

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: Fall - 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): (BL 1040 or BE 2400) and BL 2020

BE 5000 - Graduate Research
Includes the study of an acceptable biomedical engineering problem and the preparation of a report or thesis.
Credits: variable to 12.0; May be repeated; Graded Pass/Fail Only
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate

BE 5100 - Cell and Tissue Mechanics
Focuses on mechanical behavior and adaptation of musculoskeletal tissues including material properties, viscoelasticity, fatigue and failure. Includes the role of mechanical forces in the development, growth and adaptation of musculoskeletal tissues; cell biology and cellular mechanotransduction.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2009-2010 academic year
Restrictions: Must be enrolled in one of the following Level(s): Graduate

BE 5110 - Neuroengineering
Brief overview of neuroanatomy, neurophysiology, and neurobiology followed by introductions of more advanced topics including neural tissue engineering, neural/ electrode interfaces, and functional electrical stimulation.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2010-2011 academic year
Restrictions: Must be enrolled in one of the following Level(s): Graduate

BE 5200 - Biology for Engineers 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: Fall - Offered alternate years beginning with the 2009-2010 academic year
Restrictions: Must be enrolled in one of the following Level(s): Graduate

BE 5300 - 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 composite biomaterials.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2009-2010 academic year
Restrictions: Must be enrolled in one of the following Level(s): Graduate

BE 5510 - 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: Spring - Offered alternate years beginning with the 2010-2011 academic year
Restrictions: Must be enrolled in one of the following Level(s): Graduate

BE 5550 - Biostatistics for Health Science Research
An overview course of biostatistical methods used in the health sciences. Topics include a review of undergraduate statistical concepts, NIH, CDC, and FDA guidelines for clinical trial research, proper use of biostatistical methods including anova models, logistic regression, risk analysis, survival analysis and any other statistical methods that are common in the enrolled students' discipline.
Credits: variable to 4.0
Semesters Offered: On Demand
Pre-Requisite(s): MA 2720 or MA 3710

BE 5600 - Drug and Gene Delivery
Covers drug pharmacodynamics and pharmacokinetics. Provides a fundamental overview of the different drug delivery systems. Students will be introduced to polymers used to deliver therapeutics. Term project involves developing new technologies/therapeutics to treat diseases.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2009-2010 academic year
Restrictions: Must be enrolled in one of the following Level(s): Graduate

BE 5660 - Active Implantable Devices
Implantable devices that are actively delivering therapy and acting as monitoring tools will be covered. Emphasis will be on the technology and its application. Devices include electrical stimulators, pumps & diagnostic instrumentation.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2010-2011 academic year
Restrictions: Must be enrolled in one of the following Level(s): Graduate
BE 5700 - Biosensors
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: Must be enrolled in one of the following Level(s): Graduate

BE 5770 - 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: Spring - Offered alternate years beginning with the 2010-2011 academic year  
Restrictions: Must be enrolled in one of the following Level(s): Graduate

BE 5800 - Advanced 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 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  
Restrictions: Must be enrolled in one of the following Level(s): Graduate

BE 5880 - Principles and Analysis of Cellular Processes
Course includes an overview of organic chemistry, biochemical principles of DNA and protein structure, and analytical methods including micro-array chips, fluorescent methods of detection, and immunoassays as well as ISO-10,993 procedures for the evaluation of biological response to medical devices.
Credits: 3.0  
Lec-Rec-Lab: (3-0-0)  
Semesters Offered: Fall - Offered alternate years beginning with the 2010-2011 academic year  
Restrictions: Must be enrolled in one of the following Level(s): Graduate

BE 5900 - Biomedical Engineering Topics
Biomedical engineering courses will be offered as professional electives dependent upon the interest of the faculty.
Credits: variable to 6.0; May be repeated  
Semesters Offered: Fall, Spring, Summer  
Restrictions: Must be enrolled in one of the following Level(s): Graduate

BE 5940 - Introduction to Tissue Engineering
Explore 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: Fall - Offered alternate years beginning with the 2010-2011 academic year  
Restrictions: Must be enrolled in one of the following Level(s): Graduate

BE 5990 - Biomedical Engineering Graduate Seminar
Presentations and discussion by graduate students and guest speakers on the field of biomedical engineering.
Credits: 1.0; Repeatable to a Max of 2; Graded Pass/Fail Only  
Lec-Rec-Lab: (0-1-0)  
Semesters Offered: Fall  
Restrictions: Must be enrolled in one of the following Level(s): Graduate

BE 6000 - Doctoral Research
Includes the study of an acceptable biomedical engineering problem and the preparation of a report or thesis.
Credits: variable to 12.0; May be repeated; Graded Pass/Fail Only  
Semesters Offered: Fall, Spring, Summer  
Restrictions: Must be enrolled in one of the following Level(s): Graduate

BE 6900 - Biomedical Engineering Topics
Biomedical engineering courses will be offered as professional electives dependent upon the interest of the faculty.
Credits: variable to 6.0; May be repeated  
Semesters Offered: Fall, Spring, Summer  
Restrictions: Must be enrolled in one of the following Level(s): Graduate

BE 6975 - Full-Time Doctoral Research
Open to students who have successfully completed all required courses as well as the comprehensive and proposal defense exams. Students in this course are involved in full-time research. Tuition for this course is charged at the graduate full-time research rate. Students enrolled in this course may not register for any other course.
Credits: 9.0; May be repeated; Graded Pass/Fail Only  
Lec-Rec-Lab: (0-9-0)  
Semesters Offered: Fall, Spring, Summer  
Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

Biological Sciences

BL 0600 - Clinical Practicum and Career Preparation Seminar
Presents an overview of hospital-based clinical practicum experiences and outlines pathways to national certification. Also addresses other career options for the clinical laboratory scientist. Credits do not count toward graduation.
Credits: 1.0; Graded Pass/Fail Only  
Lec-Rec-Lab: (0-1-0)  
Semesters Offered: Spring  
Restrictions: Must be enrolled in one of the following Major(s): Clinical Laboratory Science; May not be enrolled in one of the following Class(es): Freshman

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): Clinical 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  
Restrictions: Must be enrolled in one of the following Major(s): Clinical Laboratory Science, Biological Sciences

BL 1040 - Principles of Biology
Introduction to various careers in the medical field. Discusses required course work, entrance exams, and other requirements for entry to the various fields. Guest lecturers include representatives of many medical fields.
Credits: 1.0  
Lec-Rec-Lab: (0-1-0)  
Semesters Offered: Fall

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

BL 1950 - Introduction to Pre-Medicine
Introduces to various careers in the medical field. Discusses required course work, entrance exams, and other requirements for entry to the various fields. Guest lecturers include representatives of many medical fields.
Credits: 1.0  
Lec-Rec-Lab: (1-0-0)  
Semesters Offered: Fall

BL 1600 - Introduction to Clinical Laboratory Science
Introduction to the fields and career opportunities in the biological sciences.
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
Restrictions: Must be enrolled in one of the following College(s): College of Sciences & Arts

BL 1900 - Molecular Biology Seminar
Discussion of current molecular topics in modern biology. Topics include applications in medicine and agriculture, gene therapy, genetically modified organisms, cloning, stem cells, use of these problem solving techniques in forensics and genetic disease, ethics.
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Spring

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
Pre-Requisite(s): CH 1100 or CH 1110 or CH 1112 or (CH 1150 and CH 1151 and CH 1153)

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(C)

BL 2021 - Anatomy & Physiology II 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
Pre-Requisite(s): BL 2010(C)

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: Spring
Pre-Requisite(s): BL 1010 or BL 1040

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
Pre-Requisite(s): BL 2200(C)

BL 2400 - Biology for Engineers I
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
Restrictions: May not be enrolled in one of the following Level(s): Graduate; May not be enrolled in one of the following Class(es): Senior

BL 2410 - Basic Clinical Laboratory Techniques
Introduces a variety of fundamental diagnostic procedures performed in a typical clinical laboratory.
Credits: 3.0
Lec-Rec-Lab: (2-0-3)
Semesters Offered: Fall

BL 2940 - Human Nutrition
Covers basic and applied chemistry and biology of human nutrition. Includes practical information on planning and adopting a healthy diet as well as maintaining acceptable weight. Emphasizes social, global, and environmental issues pertinent to use of the world food supply.
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 1020 and BL 1710

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: Spring
Pre-Requisite(s): CH 1140 or CH 2400 or (CH 2410 and CH 2420)

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): CH 1140 or CH 2400 or (CH 2410 and CH 2420)

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 3230 - Medical Bacteriology
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
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: 3.0
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): BL 2200

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: 3.0
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): 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: 3.0
Lec-Rec-Lab: (2-0-3)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Major(s): Clinical Laboratory Science, Biological Sciences; May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): BL 1040 or BL 3070

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: 4.0
Lec-Rec-Lab: (3-0-3)
Semesters Offered: Fall
Pre-Requisite(s): BL 1020 or BL 1040

BL 3640 - General Immunology

Investigates the immune defense system that has evolved to protect vertebrates from invading pathogens and cancer. Covers general principals of innate and acquired immunity, immunodeficiency and autoimmune diseases, as well as transplantation immunology, and the role of apoptosis in lymphocyte maturation.

Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Major(s): Biochem & Molec Biology-Bio Sc, Biological Sciences, Clinical Laboratory Science, Biomedical Engineering, Bioinformatics; May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): BL 1040 or BL 4010 or BL 2040

BL 3780 - Medical Parasitology Laboratory

Stresses the visual identification of common human parasites.

Credits: 1.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Major(s): Clinical Laboratory Science, Biological Sciences; May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): BL 1710 and BL 2410

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: 3.0
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 2002

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 - Special Problems 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 4010 - 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, Clinical 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: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Pre-Requisite(s): (BL 1020 or BL 1040 or BL 2010) and BL 2100 and (CH 2400 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: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
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: 3.0
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 1020 or BL 1040 and (BL 2100 or CH 4710)

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

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

BL 4130 - Phycology

Morphology, distribution, physiology, ultrastructure, taxonomy, and economic significance of freshwater and marine algae.

Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2001-2002 academic year
Pre-Requisite(s): BL 2160

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 4200 - Applied and Industrial Microbiology

Discussion of microbial involvement in areas such as industrial production processes, biodeterioration, and organic and inorganic waste treatment. Also reviews current literature in these areas.

Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2001-2002 academic year
Pre-Requisite(s): BL 3210 or BL 3310

BL 4230 - Virology

Comparison of bacterial, animal, and plant viruses, including a detailed study of viral structure and host-virus interaction in the viral replication process. Discusses important current areas of viral research, viralimmune suppression, and oncogene theory.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2003-2004 academic year
Pre-Requisite(s): BL 2100(C)

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BL 4320 - Histology
Basic tissue structures and organs of the vertebrate organisms with emphasis on the human.
Credits: 4.0
Lec-Rec-Lab: (0-3-3)
Semesters Offered: Spring
Pre-Requisite(s): BL 2010 and BL 2020

BL 4370 - Cell Biology
Celebration of the commonalities of life as exhibited in the basic building block of organisms - the cell. Course topics include details of basic genetic mechanisms, cell structure and function, and an examination of cells in their social context.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): BL 2200 and CH 2420

BL 4380 - Cardiopulmonary Physiology
Using a problem-based learning approach, course examines the physiology of the human body. In-class case-study analyses provide in-depth learning about the cardiovascular and pulmonary systems and their relationship with other organ systems. Promotes development of problem-solving skills.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Pre-Requisite(s): BL 2020

BL 4430 - Biological Simulation Techniques
Introduction to the use of mathematical techniques for simulation of biological phenomena, including programming techniques for computers.
Credits: 3.0
Lec-Rec-Lab: (2-0-3)
Semesters Offered: Spring
Pre-Requisite(s): (BL 1020 or BL 1040) and (MA 1135 or MA 1160 or MA 1161)

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 4450 - Limnology
Introductory study of interrelated physical, chemical, and biological processes of freshwater lakes. Field work on local lakes emphasized.
Credits: 4.0
Lec-Rec-Lab: (0-3-3)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): CH 1120 or CH 1122 or (CH 1160 and CH 1161)

BL 4455 - Research Methods in Aquatic Ecology
This field and laboratory based course for graduate students and advanced undergraduate students will provide exposure to a broad array of fresh water ecosystems and the current methods for quantitatively sampling them. We will explore the fish, invertebrates, and algae in streams, wetlands, Lake Superior, and smaller lakes using traditional and more novel sampling techniques framed by ecosystemic, taxonomic, ecological, historical, and evolutionary science.
Credits: 3.0
Lec-Rec-Lab: (0-2-3)
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, Junior
Pre-Requisite(s): CH 1120 or CH 1122 or (CH 1160 and CH 1161)

BL 4460 - Biodiversity & Freshwater Ecosystems
Course is designed for upper level undergraduate and graduate students interested in a broader understanding of Biodiversity and life's most precious and necessary resource - freshwater. Class will be a discussion of book chapters, scientific journal articles, contributed case study presentations by students, and a seminar paper.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2007-2008 academic year
Pre-Requisite(s): BL 1020 or BL 1040 or BL 3400

BL 4470 - Analysis of Biological Data
Methods and techniques of analyzing quantitative biological data and of designing biological experiments.
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): MA 1135 or MA 1160 or MA 1161

BL 4500 - Critical Discussions in Bioinformatics
Critical discussions of current topics in bioinformatics. Oral and written presentations requiring synthesis of information from various sources including primary literature.
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-Requisite(s): BL 3300

BL 4510 - Senior Essay
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 - Offered alternate years beginning with the 2007-2008 academic year
Pre-Requisite(s): BL 2200(C)

BL 4550 - Clinical Chemistry
Theory and technique used in the routine and experimental analysis of body fluids. Includes the study of kidney and liver functions, electrolytes, medically important enzymes, protein electrophoresis, microanalytical techniques, and the use of automated analytical equipment.
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; May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): BL 2020 and BL 2410 and BL 3640

BL 4610 - Clinical Laboratory Science Clinical 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
Restrictions: Must be enrolled in one of the following Major(s): Clinical Laboratory Science
Pre-Requisite(s): BL 2020 and BL 2410 and BL 3640

BL 4611 - Clinical Laboratory Science Clinical 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. Acceptance by a NAACLS-approved/accredited histological technology and/or histotechnologist hospital internship program required.
Credits: 15.0
Lec-Rec-Lab: (15-0-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Major(s): Clinical Laboratory Science
Pre-Requisite(s): BL 4610

BL 4620 - Histotechnology Practicum I
Practical and didactic training in sample processing, micromute use, staining, instrumentation, grossing, embedding, and microscopy under the direction of National Accrediting Agency for the Clinical Laboratory Sciences (NAACLS)-approved/accredited hospital internship program personnel.
Credits: 14.0
Lec-Rec-Lab: (14-0-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Major(s): Clinical Laboratory Science

BL 4630 - Histotechnology Practicum II
Practical and didactic training in general histological techniques, including embedding, sectioning, and staining.
Credits: 14.0
Lec-Rec-Lab: (14-0-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Major(s): Clinical Laboratory Science

BL 4640 - Histotechnology Practicum III
Practical and didactic training in general histological techniques, including embedding, sectioning, and staining.
Credits: 14.0
Lec-Rec-Lab: (14-0-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Major(s): Clinical Laboratory Science

BL 4650 - Histotechnology Practicum IV
Practical and didactic training in general histological techniques, including embedding, sectioning, and staining.
Credits: 14.0
Lec-Rec-Lab: (14-0-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Major(s): Clinical Laboratory Science

BL 4660 - Histotechnology Practicum V
Practical and didactic training in general histological techniques, including embedding, sectioning, and staining.
Credits: 14.0
Lec-Rec-Lab: (14-0-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Major(s): Clinical Laboratory Science

BL 4670 - Histotechnology Practicum VI
Practical and didactic training in general histological techniques, including embedding, sectioning, and staining.
Credits: 14.0
Lec-Rec-Lab: (14-0-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Major(s): Clinical Laboratory Science

BL 4680 - Histotechnology Practicum VII
Practical and didactic training in general histological techniques, including embedding, sectioning, and staining.
Credits: 14.0
Lec-Rec-Lab: (14-0-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Major(s): Clinical Laboratory Science
BL 4621 - Histotechnology Practicum II
Practical and didactic training in histotechnology, DNA immunohistochemistry techniques, research methods, management, and safety under the direction of the National Accrediting Agency for the Clinical Laboratory Sciences (NAACLS)-approved/accredited hospital internship program personnel.
Credits: 14.0
Lec-Rec-Lab: (14-0-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Major(s): Clinical Laboratory Science
Pre-Requisite(s): BL 4620

BL 4630 - Cytotechnology Practicum I
Practical and didactic training in recognition of normal cells and cellular changes, particularly malignant, in the female reproductive tract, respiratory tract, and gastrointestinal tract under the direction of Committee on Accreditation of Allied Health Education Programs (CAAHEP)-approved/accredited hospital internship program personnel. Acceptance by a CAAHEP-approved/accredited cytotechnology hospital internship program required.
Credits: 14.0
Lec-Rec-Lab: (14-0-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Major(s): Clinical Laboratory Science

BL 4631 - Cytotechnology Practicum II
Practical and didactic training in normal cell identification and recognition of cellular changes with emphasis on the diagnosis of cancer in the urinary, excretory, and neurological systems under the direction of Committee on Accreditation of Allied Health Education Programs (CAAHEP)-approved/accredited hospital internship program personnel.
Credits: 14.0
Lec-Rec-Lab: (14-0-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Major(s): Clinical Laboratory Science

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: Permission of instructor required

BL 4650 - Introducion to Mycology
The taxonomy and biology of major groups of fungi, focusing on their ecology and physiology. Emphasizes organisms of interest in medicine and forest ecology.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Major(s): Clinical Laboratory Science, Biological Sciences; Must be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): BL 4720(C)

BL 4670 - Hematology and Hemostasis
Theory and laboratory applications. Emphasis will be placed on hematology, normal and disease states affecting blood cells and coagulation processes. The lab will focus on cell morphology and practical testing applications.
Credits: 3.0
Lec-Rec-Lab: (2-0-3)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Major(s): Clinical Laboratory Science, Biological Sciences; Must be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): BL 4730(C)

BL 4700 - Plant Taxonomy
The classification system and the criteria for classification employed in the plant kingdom with emphasis on identification of vascular plants. A three-week field course during 1st track of summer semester. Class days include Saturdays.
Credits: 3.0
Lec-Rec-Lab: (0-2-3)
Semesters Offered: Spring
Pre-Requisite(s): BL 4010(C) or CH 4710(C)

BL 4720 - Hematology and Hemostasis
Recent developments in Clinical Laboratory Science.
Credits: variable to 4.0; Repeatable to a Max of 8
Semesters Offered: Fall, Spring
Restrictions: Permission of instructor required

BL 4730 - Immunohematology Techniques
Theory and practical applications. Emphasis will be placed on blood antigens and antibodies, compatibility testing techniques, blood component therapy and safety issues.
Credits: 1.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Major(s): Clinical Laboratory Science, Biological Sciences; Must be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): BL 4720(C)

BL 4740 - Introduction to Mycology
The taxonomy and biology of major groups of fungi, focusing on their ecology and physiology. Emphasizes organisms of interest in medicine and forest ecology.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Fall - Offered alternate years beginning with the 2009-2010 academic year
Pre-Requisite(s): BL 1020 or BL 1040
BL 4995 - Research in Biochemistry
A literature and laboratory research problem in biochemistry that culminates in a written report on the work performed.
Credits: variable to 6.0; 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): Biochem & Molec Biology-Bio Sc, Chemistry, Clinical Laboratory Science, Bioinformatics, Biological Sciences; May not be enrolled in one of the following Class(es): Freshman

BL 5020 - Enzymology
Detailed biochemical analysis of enzyme structure-function relationships, enzyme mechanisms, and enzyme kinetics. Topics include details of advanced protein and ribozyme structure, enzyme co-factors and other post-translational modifications, spectroscopy as applied to kinetic measurements and structural determination, as well as the rational design and directed evolution of enzyme function and stability for biotechnological applications.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring - Offered alternate years beginning with the 2007-2008 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

BL 5030 - Molecular Biology
Molecular biology of gene structure, expression and regulation. Molecular techniques and their application to biotechnology and genomes are covered.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Level(s): Graduate

BL 5040 - Electron Optical Methods of Analysis I: Principles and Techniques for Biologists
Hands-on course focusing on use of transmission electron microscopes. Topics include sample preparation for biology, transmission electron optics, specimen-beam interactions, operating parameter choices, image formation and processing. Successful completion of course is the prerequisite to becoming a certified operator, MTU Electron Optics Facility. (This is a half semester course.)
Credits: 2.0
Lec-Rec-Lab: (0-3-3)
Semesters Offered: Fall - Offered alternate years beginning with the 2002-2003 academic year
Restrictions: Must be enrolled in one of the following Level(s): Graduate

BL 5050 - Electron Optical Methods of Analysis II: Principles and Techniques for Biologists
Hands-on course focusing on the use of transmission electron microscopes. Topics: sample preparation for biology, transmission electron optics, specimen-beam interactions, operating parameter choices, image formation and processing. Successful completion of course is the prerequisite to becoming a certified operator in the MTU Electron Optics Facility. (This is a half semester course.)
Credits: 2.0
Lec-Rec-Lab: (0-3-3)
Semesters Offered: Fall - Offered alternate years beginning with the 2002-2003 academic year
Restrictions: Must be enrolled in one of the following Level(s): Graduate

BL 5060 - Biological Ultrastructure
Microscopical investigations of biological specimens with transmission and scanning electron, scanning tunneling, and atomic force. Basic laboratory techniques include fixation and embedding, ultrathin sectioning, critical point drying, sputter coating. Also includes advanced cytochemical, cryo- and high-resolution techniques.
Credits: 4.0
Lec-Rec-Lab: (0-2-6)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): BL 5040 or BL 5050

BL 5150 - Advanced Plant Physiology
Comprehensive study of metabolic activities and growth processes of plants. Emphasizes water relations and growth at the submicroscopic, microscopic, and macroscopic levels. Prerequisite: a course in plant physiology.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

BL 5160 - Plant Biochemistry and Molecular Biology
Biochemical principles underlying central processes unique to plants, including photosynthesis and symbiotic nitrogen fixation. Also covers fundamentals of plant molecular biology including transformation of plants and regulation of gene expression. Background required: one year of biochemistry and a course in plant physiology.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate

BL 5170 - Plant Cell & Development
Cellular, molecular processes involved in plant development. In-depth study of the structure and function of the plant cell as related to plant development. Such topics as control of iterative growth, cellular basis of form, cell differentiation, competence, determination and coordination of development. Background required: course in biochemistry and in plant physiology.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate

BL 5200 - Microbial Physiology
Structure and function of microorganisms, with emphasis on mechanisms for responding to changing environmental and nutritional conditions.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2000-2001 academic year
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): BL 3210 or BL 3310

BL 5340 - Special Topics in Biology
A discussion of recent developments in the biological sciences. Recent offerings have included population genetics, taxonomy of aquatic insects, herpetology, bryology, fungi, and lichens.
Credits: variable to 10.0; Repeatable to a Max of 10
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate

BL 5350 - Special Topics in Physiology
A discussion of recent developments in physiology. Recent offers have included respiratory physiology, renal physiology, clinical cardiology, and neurophysiology.
Credits: variable to 10.0; Repeatable to a Max of 10
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate

BL 5360 - Special Topics in Biochemistry
A discussion of recent developments in the field of biochemistry. Topics taught recently include steroid biochemistry, immunology, and metabolic control theory.
Credits: variable to 10.0; Repeatable to a Max of 10
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate

BL 5370 - Special Topics in Microbiology
A discussion of recent developments in the field of microbiology. Topics taught recently include bacterial genetics, industrial microbiology, and advanced microbial ecology.
Credits: variable to 10.0; Repeatable to a Max of 10
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate

BL 5380 - Special Topics in Ecology
A discussion of recent developments in the field of ecology. Topics taught recently include systems ecology, ecology of Great Lakes fisheries, ecology of algae, aquatic macrophytes, and world ecosystems.
Credits: variable to 10.0; Repeatable to a Max of 10
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate

BL 5390 - Special Topics in Clinical Laboratory Science
A discussion of recent developments in clinical laboratory science.
Credits: variable to 10.0; Repeatable to a Max of 10
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate

BL 5400 - Special Topics in Plant Sciences
A discussion of recent developments in plant science. Topics may include biotechnology, physiology, systematics, phylogenetics, biochemistry, and molecular genetics.
Credits: variable to 10.0; Repeatable to a Max of 10
Semesters Offered: Spring - Offered alternate years beginning with the 2007-2008 academic year
Restrictions: Must be enrolled in one of the following Level(s): Graduate

BL 5431 - Population Ecology
The distribution and abundance of organisms, including theoretical, laboratory, and field studies of factors limiting population growth. Examines biological limitations, including competition, predation, parasitism, and disease.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2007-2008 academic year
Restrictions: Must be enrolled in one of the following Level(s): Graduate
BL 5451 - Aquatic Ecology
Integrated coverage of flowing and standing fresh water environments, including biological, physical, and chemical factors and their interactions. Applied aspects include biological responses to stress, fisheries, and the management of aquatic systems. Emphasizes the fundamentals of aquatic systems and fieldwork on local environments.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2007-2008 academic year
Restrictions: Must be enrolled in one of the following Level(s): Graduate

BL 5460 - Advanced Ecology: Ecosystems
Comparison of ecosystem structure and processes with emphasis on lakes. Stresses critical reading of recent journal literature.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2000-2001 academic year
Restrictions: Must be enrolled in one of the following Level(s): Graduate

BL 5500 - Graduate Seminar in Biological Sciences
Analysis, evaluation, and synthesis of primary scientific literature on a specific topic in recitation/discussion format.
Credits: 1.0; Repeatable to a Max of 4
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate

BL 5501 - Graduate Research Seminar Ecology/Environmental Seminar is designed to facilitate critical discussions of student research projects at various stages of their development. The presenter will provide an overview or seminar on their project and research goals, which will establish the foundation for the discussion thereafter.
Credits: 1.0; May be repeated
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

BL 5502 - Biological Sciences Seminar
A seminar course for the presentation, interpretation and integration of current research topics.
Credits: 1.0; Repeatable to a Max of 97
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate

BL 5503 - Graduate Research Seminar Biomolecular Seminar is designed to facilitate critical discussions of student research projects at various stages of their development. The presenter will provide an overview or seminar on their project and research goals, which will establish the foundation for the discussion thereafter.
Credits: 1.0; May be repeated
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

BL 5520 - Satellite Limnology
Provides an overview of historical, current applications of satellite remote sensing in limnologic research, including remote sensing of lake surface temperatures and ice, application of satellite image analysis for evaluating water quality variables (e.g., suspended solids and chlorophyll), development of a new lake, ocean color algorithms, and review of satellite instrument capabilities.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

BL 5560 - Biodiversity/Freshwater Ecosys
Course is designed for upper level undergraduates and graduate students interested in a broader understanding of Biodiversity and life's most precious and necessary resource - freshwater. Class will be a discussion of book chapters, scientific journal articles, contributed case study presentations by students, and a seminar paper.
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, Sophomore, Junior
Pre-Requisite(s): BL 1020 or BL 1040 or BL 3400

BL 5680 - Bryology
Emphasizes the broad aspects of bryology, including physiology, ecology, development, taxonomy, and evolution with an ecological theme that is fortified with laboratory examination of structures and field identification of bryophyte species, communities, and adaptations.
Credits: 4.0
Lec-Rec-Lab: (3-0-3)
Semesters Offered: Spring - Offered alternate years beginning with the 2004-2005 academic year
Restrictions: Must be enrolled in one of the following Level(s): Graduate

BL 5681 - Field Bryology
A field course in the identification of mosses, liverworts and hornworts. Field trips will include various sites in the Keweenaw Peninsula. This intensive course will be taught as one week of field trips in the Keweenaw Peninsula.
Credits: 1.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Summer - Offered alternate years beginning with the 2005-2006 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

BL 5750 - Advanced Ecology: Communities
Discussion of factors that determine plant and animal species distribution, abundance, and diversity. Emphasis on theoretical concepts involves critical reading of recent literature.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

BL 5975 - Full-Time Master's Research
Open to students who have successfully completed all the required courses as well as the required number of credits for the master's degree. Students in this course are involved in full-time research. Tuition for this course is charged at the graduate full-time research rate. Students enrolled in this course may not register for any other course.
Credits: 9.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-9-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

BL 5990 - Masters Research in Biological Sciences
An original investigation in biology that culminates in a thesis.
Credits: variable to 15.0; Repeatable to a Max of 15; Graded Pass/Fail Only
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate

BL 6975 - Full-Time Doctoral Research
Open to students who have successfully completed all required courses as well as the comprehensive and proposal defense exams. Students in this course are involved in full-time research. Tuition for this course is charged at the graduate full-time research rate. Students enrolled in this course may not register for any other course.
Credits: 9.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-9-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

BL 6990 - Doctoral Research in Biological Sciences
An original investigation in theoretical or experimental biology, or both, and submission of a dissertation in partial fulfillment of the requirements for the PhD degree.
Credits: variable to 45.0; Repeatable to a Max of 45; Graded Pass/Fail Only
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

Civil & Environmental Engng

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, life-long learning, contemporary issues, ethics and societal impacts related to civil engineering.
Credits: 1.0
Lec-Rec-Lab: (1-0-0)
Semesters Offered: Fall

CE 1501 - Experiences in Environmental Engineering
Provides a series of activities that explore the field of environmental engineering. Through completion of the course, students will gain fundamental experiences with the skills, knowledge, and attitudes needed to solve the complex environmental problems needing solutions from today's environmental engineers.
Credits: 1.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Fall
CE 2201 - Structural Engineering I
The application of statics and mechanics of materials to the analysis of trusses, determinant and indeterminate beams, and small frames. An introduction to the application of dynamics to civil engineering problems.
Credits: 4.0
Lec-Rec-Lab: (0-3-2)
Semesters Offered: Fall, Spring
Pre-Requisite(s): ENG 2120 or MEEM 2150

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 3201 - Structural Engineering II
Introduction to the design of basic civil engineering structural components in steel and reinforced concrete. The Load and Resistance Factor Design method is applied to steel tension, compression, and flexural members and to basic connections. The Ultimate Strength Design method is applied to concrete flexural members.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): CE 2201

CE 3331 - Professional Practice
Technical, legal, and ethical considerations in civil engineering practice are illustrated through examination of contract specifications and technical specification writing.
Credits: 2.0
Lec-Rec-Lab: (2-0-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: May not be enrolled in one of the following Class(es): Freshman

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

CE 3401 - Transportation Engineering
Introduction to transportation in the United States, highway types and systems, principles of route location, vehicle characteristics, highway geometrics and design standards, drainage, environmental considerations, pavement design, and economic principles and engineering criteria for highway improvements.
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

CE 3501 - Environmental Engineering Fundamentals
Basic principles and calculations for environmental engineering. Covers application of mass balance, energy balance, and physical/chemical/biological principles to water and wastewater treatment, surface water quality, air quality, solid waste management, and groundwater quality.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): MA 2160 and CH 1100 or CH 1110 or CH 1112 or (CH 1150 and CH 1151)

CE 3502 - Environmental Monitoring and Measurement Analysis
Introduction to environmental data acquisition and interpretation, fundamentals of environmental monitoring, instrumentation, measurement techniques, and statistical analyses. Measurements are conducted in a variety of engineered and natural environments. Probability and statistical analyses are applied to the collected data.
Credits: 3.0
Lec-Rec-Lab: (0-2-3)
Semesters Offered: Spring
Pre-Requisite(s): MA 2160 and CH 1100 or CH 1110 or CH 1112 or (CH 1150 and CH 1151)

CE 3503 - 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 1100 or CH 1110 or CH 1112 or (CH 1150 and CH 1151)

CE 3504 - Water Resources Engineering
Introduction to hydrologic engineering, including rainfall-runoff modeling and hydrologic frequency analysis. Analysis and design of hydraulic systems such as pipe networks and storm water management systems. Computational, field, and experimental laboratory sessions reinforce lectures and provide hands-on learning opportunities.
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
Pre-Requisite(s): (ENG 3200 or ENG 3507) and (MA 3710(C) or CE 3502(C))

CE 3550 - 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 3810 - Soil Mechanics for Engineers
Introduces three-dimensional structures. Studies design of selected simple and rigid connections. An experimental laboratory experience reinforces the lecture material.
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 or ENG 3507)

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

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
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: Fall
Pre-Requisite(s): CE 3201

CE 4211 - Reinforced Concrete Design
Design of reinforced concrete two-way slab systems and elements of continuous frames, including beams for combined torsion and shear, and short and slender columns. Isolated, combined, and continuous footings will also be considered.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): CE 3201

CE 4221 - Structural Steel Design
Design of steel frame structures by the Load and Resistance Factor Design method. Covers flexural members including unbraced beams, and plate girders as well as columns under combined bending and axial loads, including basic moment magnification techniques. Studies design of selected simple and rigid beam to column connections and introduces composite members.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): CE 3201
CE 4231 - Timber and Masonry Design
Introduction to timber design and wood as a structural engineering material. Includes beams, columns, and nailed and bolted connections. Introduction to masonry materials and design. Includes flexural design, pilasters, and shear wall design.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): CE 3201

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 3331 and CE 3332

CE 4335 - Building Construction
Introduction to means, methods, materials, components and processes used to construct commercial, industrial and residential buildings in the U.S. Focuses on terminology and practical applications common to the construction industry through visual presentations construction drawing interpretation and industry practitioners.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Summer
Pre-Requisite(s): CE 3101

CE 4338 - Computer Based Project Management
Integrate information from scheduling and estimating computer programs to use as tools to monitor, control, and manage projects. The course will develop a student's ability to use computer tools to interconnect the traditionally isolated project cost and schedule information.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Summer
Pre-Requisite(s): CE 3332

CE 4401 - Pavement Design
Introduces pavement design, interpretation of project and specifications, methods and procedures 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

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

CE 4403 - Traffic Safety Engineering
Traffic crash reporting, crash information and record systems, driver behavior, ROADSOF, roadside design, road safety audits, intersection safety analysis, and tort liability.
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): CE 3401 and CE 4402

CE 4404 - Introduction to Railroad Engineering
Overview of basic elements and roles of rail transportation, history, organizations and economics, safety, intercity and 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
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

CE 4405 - International Railroad Engineering
Overview of basic elements and roles of rail transportation, history, organizations and economics, safety, intercity and passenger rail, freight operations, track-train dynamics, signals and communications, motive power and equipment, track components, construction and maintenance. Incorporates technical field visits in the United States and Europe.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Summer
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

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 4501 - Environmental Engineering Chemical Processes
Application of chemical, conservation principles, and mathematics to the analysis of chemical processes occurring in natural and engineered environments. Topics include acid-base phenomena, the carbonate system, precipitation/dissolution, redox chemistry, diffusion, mass transfer, and applications to environmental design. Laboratory experiences illustrate principles and modern measurement.
Credits: 4.0
Lec-Rec-Lab: (2-0-3)
Semesters Offered: Fall
Pre-Requisite(s): (CE 3501 or CE 3503) and CE 3502 and (CH 3500(C) or CH 3501(C))

CE 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): CE 3501 or CE 3503

CE 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): CE 3501 or CE 3503

CE 4506 - Application of Sustainability Principles & Environmental Regulations 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): CE 3501 or CE 3503

CE 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, air distribution and collection systems, and their appurtenances.
Credits: 3.0
Lec-Rec-Lab: (2-0-1)
Semesters Offered: Spring
Pre-Requisite(s): CE 3501 or CE 3503 and CE 3620

CE 4508 - Water and Wastewater Treatment
Principles of physical, chemical and biological processes employed in water and wastewater treatment. Design of selected individual units within water and wastewater treatment systems.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Pre-Requisite(s): (CE 3501 or CE 3503) and (ENG 3200 or ENG 3507)

CE 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): (CE 3501 or CE 3503) and CE 3620 and CE 4501 and CE 4508
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
Restrictions: Permission of instructor required; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

CE 4512 - Green Engineering Design for Sustainability
Challenges to sustainability, the role of engineering design in achieving sustainability, the current approach to engineering design (process design, material selection and energy consumption) in the context of infrastructure systems, the principles and application of green engineering.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Pre-Requisite(s): ENG 1102 and MA 2160

CE 4513 - Physical Chemical Processes - Drinking Water Treatment
Advanced theory, fundamentals, and application of physical and chemical processes employed in design and operation of drinking water treatment systems.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Class(es): Senior
Pre-Requisite(s): CE 4501 and CE 4508

CE 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): CE 4504 and CE 4501 or (CH 3510 and CH 3520(C))

CE 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): CE 3510 or CE 4501(C)

CE 4610 - Civil and Environmental Engineering Systems Analysis
Introduction to operations research with applications to civil and environmental engineering. Decision analysis and optimization techniques, including linear programming, nonlinear programming, and dynamic programming. Computer-based solutions of design problems in various civil engineering specialty areas are considered.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2005-2006 academic year
Pre-Requisite(s): MA 2160

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 3620

CE 4640 - Stormwater Management and Low Impact Development
Design techniques for stormwater collection, conveyance, infiltration, and detention storage systems are discussed, both traditional stormwater 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
Pre-Requisite(s): CE 3620

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 4840 - Aggregate Engineering & Utilization
Introduction into various aspects of aggregate exploration, production, and utilization. Topics covered include geophysical techniques for aggregate exploration, environmental issues in aggregate production including surface and underground mining concepts, crushing and sizing and aggregate utilization in Civil Engineering applications.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: On Demand
Pre-Requisite(s): CE 3101

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, Spring, Summer
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): CE 4900

CE 4905 - 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: Fall, Spring, Summer
Pre-Requisite(s): CE 4900

CE 4910 - Engineering Design Project I
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)
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): CE 4900

CE 4916 - International Senior Design I
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)
Restrictions: Must be enrolled in one of the following Class(es): Senior
Co-Requisite(s): CE 4916
CE 4916 - International Senior Design Field Experience
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 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

CE 4990 - Special Topics in Civil and Environmental 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

CE 5101 - 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
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): CE 3101

CE 5102 - Advanced Concrete Materials
Properties and applications of portland cement and portland cement concrete. Includes cement production, chemistry and hydration, concrete admixtures, and the properties of fresh and hardened concrete. Presents concrete microstructure and durability. Other topics include high-strength and high early-strength concrete, fiber-reinforced concrete, and advanced cement-based materials.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): CE 3101

CE 5190 - Special Topics in Civil Engineering Materials
Advanced study of materials related topics, including discussions of recent research developments at an advanced level.
Credits: variable to 3.0; Repeatable to a Max of 6
Semesters Offered: Fall, Spring, Summer

CE 5201 - Advanced Structural Analysis
Energy methods in structural analysis. Elastic buckling of beams, beam-columns, and frames, including numerical methods for buckling analysis. Introduction to finite element analysis, including one- and two-dimensional elements.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2003-2004 academic year
Pre-Requisite(s): CE 4201

CE 5202 - Finite Element Analysis
Introduction to the use of finite element methods in structural analysis. Covers the finite element formulation, 1- and 2-D elements, including isoparametric elements, axisymmetric analysis, plate and shell elements, dynamics, buckling, and nonlinear analysis.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): CE 4201

CE 5211 - Advanced Reinforced Concrete Design
Advanced topics in behavior of reinforced-concrete structures and relationships with element design. Code requirements, reasoning behind theoretical and experimental studies for understanding structural behavior, and applications to design. Other topics include deep beams, corbel design, and yield-line analysis.
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): CE 4211

CE 5212 - Prestressed Concrete Design
Theory of prestressed and post-tensioned members. Covers analysis and design of prestressed concrete beams, slabs, box girders, and bridge girders by elastic and ultimate strength methods. Precast and cast-in-place system construction techniques will be included.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): CE 3201

CE 5221 - Advanced Structural Steel Design
Critical analysis of behavior of steel and thin-walled metal structural elements. Introduction to basic concepts of structural stability. P-delta effect as used in structural design. Torsional behavior of prismatic beams, including St. Venant and warping torsion. Torsional buckling.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2000-2001 academic year
Pre-Requisite(s): CE 4221

CE 5231 - Advanced Timber Design
Design of glulam members, including tapered beams, tapered and curved beams, and arches. Covers use of timber connectors as well as design of wood shear walls and diaphragms.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2001-2002 academic year
Pre-Requisite(s): CE 4201 and CE 4231

CE 5241 - Structural Dynamics I
Free and forced vibration of undamped and damped single degree of freedom systems. Generalized coordinates and Rayleigh's method. Multiple degree-of-freedom systems, including shear buildings and frames. Frequency response analysis.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): CE 4201

CE 5242 - Structural Dynamics II
Earthquake engineering and advanced dynamic analysis. Includes time history response of multiple degree-of-freedom systems, seismicity, equivalent static force method, modal analysis, base isolation, soil-structure interaction, and an introduction to random vibrations.
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): CE 5241

CE 5243 - Probabilistic Analysis and Reliability in Civil Engineering
Basic probability and statistics, including random variables, moments, probability distributions, and regression analysis. Also examines time-to-failure analysis, capacity/demand reliability analysis, first-order reliability methods, Monte Carlo simulation, and system reliability in a civil and environmental engineering context.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): MA 3710

CE 5250 - Special Topics in Structural Engineering
Advanced study of structural engineering topics, including discussions of recent research developments at an advanced level. Topics might include loading analysis, advanced topics in steel design, composite materials for structures, and behavior of a variety of reinforcements for concrete applications.
Credits: variable to 3.0; Repeatable to a Max of 6
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate

CE 5332 - Productivity Planning and Improvement
Analysis of current trends in productivity, factors that affect productivity, and techniques to identify and improve areas of low productivity.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2001-2002 academic year
Pre-Requisite(s): CE 3332 or (BA 3610 and BA 3700)
CE 5337 - Project Delivery Systems
A study of project delivery, from feasibility through design and construction, focusing on the three contemporary systems: general contracting, design-build, and construction management.
Credits: 3.0  
Lec-Rec-Lab: (3-0-0)  
Semesters Offered: Fall  
Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Class(es): Graduate  
Pre-Requisite(s): CE 3331

CE 5338 - Project Management and Administration
Exploration of the essential elements of project management and construction administration for the design and construction industry. This includes project planning, organization, budgeting, monitoring, control, life cycle, organizational structure and characteristics, and responsibilities of project managers.
Credits: 3.0  
Lec-Rec-Lab: (3-0-0)  
Semesters Offered: Spring  
Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Class(es): Graduate  
Pre-Requisite(s): CE 3331

CE 5390 - Special Topics in Construction Engineering
Advanced study of construction engineering topics including discussion of recent research developments.
Credits: variable to 3.0; Repeatable to a Max of 6  
Semesters Offered: Fall, Spring, Summer

CE 5401 - Advanced Pavement Design
Advanced analysis, behavior, performance, and structural design of highway and airport pavements. Focuses on mechanistic characterization of pavement structures and approaches used to characterize existing structures for the purpose of rehabilitation. Subjects include advanced materials characterization, mechanistic modeling, nondestructive testing, and pavement rehabilitation. Also includes airport pavement design and rehabilitation.
Credits: 3.0  
Lec-Rec-Lab: (0-3-0)  
Semesters Offered: Spring  
Pre-Requisite(s): CE 4401

CE 5402 - Highway Design
Advanced highway design, including horizontal and vertical alignment, cross-section elements, super elevation, and other road design topics. Includes extensive use of highway design computer software with a complete roadway design project using software.
Credits: 3.0  
Lec-Rec-Lab: (0-3-0)  
Semesters Offered: Spring  
Pre-Requisite(s): CE 3401

CE 5403 - Pavement Management Systems
Principles of pavement management, including inventory, condition assessment, needs determination, and budget analysis. Emphasis on field condition assessment techniques. Presents database design to illustrate data handling techniques and introduces several software packages.
Credits: 3.0  
Lec-Rec-Lab: (0-3-0)  
Semesters Offered: Fall, Spring

CE 5404 - Transportation Planning
Introduction to urban transportation planning, travel characteristics, demand forecasting techniques, corridor studies, traffic impact studies, and public transit planning and operations.
Credits: 3.0  
Lec-Rec-Lab: (0-3-0)  
Semesters Offered: Spring

CE 5406 - 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 5407 - Advanced Airport Planning and Design
Airport capacity and delay analysis, terminal and ground access planning, security, environmental aspects, noise and land use planning, airport management and operations. Includes extensive use of airport computer simulation software packages.
Credits: 3.0  
Lec-Rec-Lab: (3-0-0)  
Semesters Offered: On Demand  
Restrictions: Permission of instructor required; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior  
Pre-Requisite(s): CE 5406

CE 5408 - Public Transit
An introduction to public transit, user characteristics, management, transit modes, data collection and surveys, planning, operations, scheduling, transit finances, and future trends.
Credits: 3.0  
Lec-Rec-Lab: (3-0-0)  
Semesters Offered: On Demand  
Restrictions: Permission of instructor required; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

CE 5409 - Railroad Track Engineering and Design
Railroad location and operation, track structure, curves, grades, subgrade and drainage, ballast and sub-ballast, ties, rail, turnout crossings, and rail facility planning and design.
Credits: 3.0  
Lec-Rec-Lab: (0-3-0)  
Semesters Offered: Spring

CE 5490 - Special Topics in Transportation Engineering
Topics of special interest in transportation engineering.
Credits: variable to 3.0; Repeatable to a Max of 6  
Semesters Offered: Fall, Spring, Summer  
Restrictions: Permission of instructor required

CE 5501 - Environmental Process Engineering
Review of mass transfer, kinetics, reactor design, and mathematical modeling principles. Includes illustration by application to several important natural systems and environmental engineering unit processes. Mathematical models of selected environmental engineering systems are developed and solved using PCs.
Credits: 3.0  
Lec-Rec-Lab: (0-3-0)  
Semesters Offered: Fall  
Restrictions: Must be enrolled in one of the following Level(s): Graduate

CE 5502 - Biological Treatment Processes
Application of kinetics, reactor theory, and microbiology to modeling and design of aerobic and anaerobic wastewater treatment systems. Topics include activated sludge process models and application of these models to process design and operation.
Credits: 3.0  
Lec-Rec-Lab: (0-2-3)  
Semesters Offered: Fall, Spring  
Restrictions: Must be enrolled in one of the following Level(s): Graduate  
Pre-Requisite(s): CE 4508

CE 5503 - Physical-Chemical Treatment Processes
Advanced theory, fundamentals, and application of physical and chemical processes employed in design and operation of drinking water treatment systems.
Credits: 3.0  
Lec-Rec-Lab: (0-3-0)  
Semesters Offered: Spring  
Restrictions: Must be enrolled in one of the following Level(s): Graduate  
Pre-Requisite(s): CE 5501

CE 5504 - Surface Water Quality Modeling
Mathematical models are applied in the solution of water quality management problems. The spatial and temporal variation of conservative and reactive substances is simulated in lakes, rivers, and embayments. Kinetic representations of natural phenomena are developed, including mass transport, biogeochemical cycling of nutrients and toxics and food web dynamics.
Credits: 3.0  
Lec-Rec-Lab: (0-2-3)  
Semesters Offered: Spring  
Pre-Requisite(s): CE 4505

CE 5505 - Biogeochemical Processes
To define what constitutes sustainable human activities, one must understand linkages among physical, chemical, and biological structures and processes that comprise our biosphere. Examine interactions between physical, chemical, and biological processes on earth; model these interactions; and identify areas where knowledge is insufficient for modeling.
Credits: 3.0  
Lec-Rec-Lab: (0-3-0)  
Semesters Offered: Fall, Spring  
Pre-Requisite(s): CE 4501

CE 5509 - 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 2005-2006 academic year  
Pre-Requisite(s): CE 4501 or CH 3510
CE 5510 - Practical Applications and Analytical Techniques for Environmental Measurements
Develop methods and skills for laboratory work required for experimental research in environmental engineering. Topics include laboratory safety, quality control/quality assurance, purchasing, and use of analytical equipment. Students select one or more of the following topics for specialized study: GC, AA, carbon analysis, HPLC, UV/VIS spectroscopy, liquid scintillation counting.
Credits: variable to 3.0
Semesters Offered: Summer
Restrictions: Permission of instructor required

CE 5511 - Air Quality and the Built Environment
Investigates the complex interaction between the engineered environments in developed and developing nations and air quality. Major topics include: air pollutant health impacts and epidemiology, indoor air quality, urban design and air quality, infrastructure and air quality, and atmospheric sustainability.
Credits: 3.0
Lec-Rec-Lab: (0-2-1)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

CE 5512 - Applied Boundary Layer Meteorology
Study of how forcing phenomena affect transport of water and chemicals in the atmospheric boundary layer and how this transport is measured in the field, including relevant aspects of fluid dynamics, boundary layer structure, surface energy balance, and flux measurement.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2006-2007 academic year
Restrictions: Must be enrolled in one of the following Level(s): Graduate

CE 5515 - 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 Level(s): Graduate
Pre-Requisite(s): CE 4501 or CH 3520

CE 5560 - Advanced Topics in Air Quality Engineering
Advanced study of topics related to atmospheric chemistry and/or modeling the transformation and transport of atmospheric pollutants.
Credits: variable to 4.0; Repeatable to a Max of 8
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required

CE 5561 - Advanced Topics in Biological Processes
Advanced study of biological processes associated with natural and engineered systems.
Credits: variable to 4.0; Repeatable to a Max of 8
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required

CE 5562 - Advanced Topics in Physical-Chemical Processes
Advanced study of physical and chemical processes that occur in natural and engineered systems.
Credits: variable to 4.0; Repeatable to a Max of 8
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required

CE 5563 - Advanced Topics in Surface Water Quality Engineering
Advanced topics related to understanding the biogeochemistry of surface waters (lakes, rivers, wetlands) and the mathematical modeling of those systems.
Credits: variable to 4.0; Repeatable to a Max of 8
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required

CE 5590 - Special Topics in Environmental Engineering
Advanced study of environmental engineering topics including discussion of recent research developments.
Credits: variable to 3.0; Repeatable to a Max of 6
Semesters Offered: Fall, Spring, Summer

CE 5610 - Civil and Environmental Engineering Systems Analysis
Operations research theory with application to civil and environmental engineering problems. Decision theory and optimization techniques, including linear programming, nonlinear programming, and dynamic programming. Computer based applications will be included.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2005-2006 academic year
Pre-Requisite(s): MA 2160

CE 5620 - Stochastic Hydrology
Application of statistics to problems in surface hydrology. Topics include the flood flow and streamflow frequency analysis, goodness-of-fit tests, model selection, treatment of historical and censored data, regionalization and regression, time series analysis, Bayesian inference, sensitivity and uncertainty analysis methods.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: On Demand
Pre-Requisite(s): CE 3620 and MA 3710

CE 5661 - GIS Applications
Application of a Geographical Information Systems (GIS) to hydrologic modeling. While the application centers on hydrologic modeling, the experiences gained are applicable to a wide variety of situations. Learn the processes of obtaining, manipulating, and generating data via ArcInfo and ArcView.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: On Demand
Pre-Requisite(s): CE 3620

CE 5664 - Water Resources Modeling
Application of fundamental principles to develop mathematical models of water resources systems. Includes application of numerical methods, programming to develop simple water resources models, and application of state-of-the-art models for hydrology and river analysis.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: On Demand
Pre-Requisite(s): CE 3620

CE 5665 - Stream Restoration
Basin 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: Fall, Spring
Pre-Requisite(s): CE 3620

CE 5666 - Water Resources Planning and Management
Economic and environmental aspects of water use. Topics include flood damage reduction, water demand and hydrologic forecasting, water supply planning, and water resource systems operation.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Pre-Requisite(s): CE 3620 and (EC 3400 or EC 3402 or ENT 3402)

CE 5668 - Cold Regions Hydrology
Analysis of the effects of fresh water ice and snow engineering projects. Topics include snow hydrology, formation, melt, transport distribution, and loading; ice formation, mechanics, bearing capacity, hydraulic effects on rivers, ice jams, and ice control.
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, Junior
Pre-Requisite(s): CE 3620

CE 5690 - Special Topics in Water Resources
Advanced study of water resources topics including discussion of recent research developments.
Credits: variable to 3.0; Repeatable to a Max of 6
Semesters Offered: Fall, Spring, Summer

CE 5710 - Modeling and Simulation Applications for Decision-Making in Complex Dynamic Systems
Introduces students to the theory and application of modeling techniques and simulations in the analysis of decision alternatives in complex engineering problems. Topics include queueing theory, system dynamics modeling, agent-based modeling, discrete event simulations, etc. Students will be required to conceptualize and implement an appropriate research/engineering problem of choice (this could be a dissertation/thesis project).
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate

CE 5720 - Descriptive Modeling of Data using Statistical and Graphical Methods
Enables students to analyze and model data using statistical and graphical methods by studying the fundamentals of probability theory and graph theory and applying relevant concepts to describe, model and analyze data sets. Topics include probability distributions, Bayes theorem, conditional independence, discrete and continuous models, regression models, hypothesis testing, and Markov chain models.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate
CE 5810 - Advanced Soil Mechanics
Provides advanced studies in the topics of soil compressibility and soil strength. Develop advanced procedures for determining stress distribution and stress changes from a fundamental basis. Students are strongly advised to take CE5820 concurrently.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Pre-Requirement(s): CE 3810

CE 5820 - Geotechnical Engineering Laboratory
Hands-on experimental lab course intended to develop understanding of soil behavior and the subtle variables that influence testing results. Tests studied include cyclic and monotonic triaxial drained and undrained strength, triaxial and one-dimensional compression, and as-compacted vs. long-term behavior of fill materials.
Credits: 3.0
Lec-Rec-Lab: (0-1-4)
Semesters Offered: Fall
Pre-Requirement(s): CE 3810

CE 5830 - Advanced Geotechnical Engineering
Applies soil mechanics to the design of foundations and earth-retaining structures. Proper input parameters are stressed, and elements include the design of conventional retaining walls, reinforced earth walls, caissons, piles, shallow foundations, de-watering systems, and the support of temporary excavations.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Pre-Requirement(s): CE 5810 and CE 5820

CE 5850 - Stability of Earth Structures
Investigates the stability of both natural and anthropogenic derived structures. Studies include the application of engineering geology to slope issues, slope stability analysis procedures, computational methods. Also covers the design and analysis of soil nail walls.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Pre-Requirement(s): CE 3810

CE 5860 - Fundamentals of Soil Behavior
Develop an understanding of the factors determining and controlling the engineering properties of a soil. Topics include crystal structure and surface characteristics, soil mineralogy, soil formation, rock weathering, soil composition, soil water, clay-water electrolyte systems, soil structure and stability, volume change behavior, and strength and deformation behavior.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring
Pre-Requirement(s): CE 3810

CE 5890 - Special Topics in Geotechnical Engineering
Advanced study of geotechnical engineering topics including discussion of recent research developments. Credits: variable to 3.0; Repeatable to a Max of 6
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate

CE 5920 - 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 6
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate

CE 5930 - 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 6
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate

CE 5975 - Full Time Master's Research
Open to students who have successfully completed all the required courses as well as the required number of credits for the master's degree. Students in this course are involved in full-time research. Tuition for this course is charged at the graduate full-time research rate. Students enrolled in this course may not register for any other courses.
Credits: 9.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-9-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

CE 5990 - Civil Engineering Graduate Seminar
Detailed study and group discussions of current literature and graduate research projects related to the broad field of civil engineering. Topics will be combined to address the student's area of interest, including construction, environmental, geotechnical, structures, transportation, and water resources. External speakers discuss current related issues.
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate

CE 5991 - Environmental Engineering Graduate Seminar I
Presentations and discussion of current literature and research related to the broad field of environmental engineering.
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall

CE 5992 - Environmental Engineering Graduate Seminar II
Presentations and discussion of current literature and research related to the broad field of environmental engineering.
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Spring

CE 5993 - Field Engineering in the Developing World
Study of applying appropriate and sustainable engineering solutions and technology in the developing world. Concepts of sustainable development are covered. Topics are drawn from several areas of engineering, including water supply/treatment, wastewater treatment, materials, solid waste, construction, and watersheds.
Credits: 2.0
Lec-Rec-Lab: (0-1-2)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate

CE 5994 - International Civil & Environmental Engineering Field Experience
Field work and reporting from students in the Peace Corps Master's International Program in Civil & Environmental Engineering.
Credits: 1.0; May be repeated
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

CE 5995 - International Engineering Master's Research
An original investigation in theoretical or experimental engineering and submission of a thesis or report in partial fulfillment of the requirements of the Master of Science degree conducted while in the Peace Corps Master's International Civil & Environmental Engineering program.
Credits: variable to 9.0
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

CE 5998 - Engineering Design Practicum
Advanced independent study for students in the Master of Engineering program. In consultation with student's advisor, develop and execute a project demonstrating capabilities in problem solving, communications, and decision making. The practicum can be done on campus or at the site of a Michigan Tech corporate partner.
Credits: variable to 4.0; Repeatable to a Max of 4
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate

CE 5999 - Master's Research
Study of an acceptable civil or environmental engineering problem and preparation of a report or thesis.
Credits: variable to 10.0; May be repeated; Graded Pass/Fail Only
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate

CE 6975 - Full-Time Doctoral Research
Open to students who have successfully completed all required courses as well as the comprehensive and proposal defense exams. Students in this course are involved in full-time research. Tuition for this course is charged at the graduate full-time research rate. Students enrolled in this course may not register for any other course.
Credits: 9.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-9-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate
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, Summer

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: 5.0
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 1122 - 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 1100 or (CH 1110 and CH 1111) or CH 1112 or (CH 1150 and CH 1151)

CH 1130 - Orientation
Discussion of career opportunities in chemistry; introduction to the ChemSci computer network. Required for all entering chemistry majors.
Credits: 1.0
Lec-Rec-Lab: (1-0-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Major(s): Chemistry

CH 1140 - Introduction to Organic, Inorganic and Biochemistry
Introduces the principles of organic, inorganic, and biochemistry. Topics include nomenclature, chemical bonding, oxidation reduction, properties of gases and liquids, and nuclear chemistry. Chemistry majors may not include this course as part of the credit requirements for graduation.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Pre-Requisite(s): CH 1100 or (CH 1110 and CH 1111) or CH 1112 or (CH 1150 and CH 1151)

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

CH 1151 - University Chemistry Lab I
Laboratory to accompany CH1150.
Credits: 1.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Fall, Spring, Summer
Co-Requisite(s): CH 1150

CH 1153 - University Chem Recitation I
Problem solving session to support University Chemistry I - CH1150.
Credits: 1.0; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-1)
Semesters Offered: Fall, Spring, Summer
Co-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
Co-Requisite(s): CH 1161
Pre-Requisite(s): CH 1100 or (CH 1110 and CH 1111) or CH 1112 or (CH 1150 and CH 1153)

CH 1161 - University Chemistry Laboratory II
Laboratory to accompany CH1160.
Credits: 1.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Fall, Spring, Summer
Co-Requisite(s): CH 1160
Pre-Requisite(s): CH 1100 or (CH 1110 and CH 1111) or CH 1112 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: 1.0; Graded Pass/Fail Only
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall, Spring, Summer
Co-Requisite(s): CH 1160
Pre-Requisite(s): CH 1100 or (CH 1110 and CH 1111) or (CH 1150 and CH 1151)

CH 2122 - 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 1120 or CH 1122 or (CH 1160 and CH 1161)

CH 2400 - Principles of Organic Chemistry
Discusses properties and reactions of various functional groups using reaction mechanisms as a unifying theme. Emphasizes practical applications using industrial, environmental, current events, and biological/medicinal examples. Not open to students whose programs require CH2410.
Credits: 4.0
Lec-Rec-Lab: (4-0-0)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Major(s): Chemistry, Biological Sciences
Pre-Requisite(s): CH 1120 or 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, Summer
Pre-Requisite(s): CH 1120 or CH 1122 or (CH 1160 and CH 1161)

CH 2411 - Organic Chemistry Lab I
Laboratory to accompany CH2410 and CH2400.
Credits: 1.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Fall, Summer
Pre-Requisite(s): (CH 2400(C) or CH 2410(C)) and CH 1120 or 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 2400 or CH 2410
Lec-Rec-Lab: Credits: Laboratory to accompany CH2420.

CH 2421 - Organic Chemistry Lab II

Pre-Requisite(s): CH 2411 and CH 2420(C)

Semesters Offered: Spring, Summer

Credits: 2.0

Lec-Rec-Lab: (0-0-4)

CH 3020 - Laboratory Teaching Internship

Requires teaching a section of undergraduate laboratory under professional supervision. Emphasizes communicating good laboratory practice and technique to beginning students as well as maintaining a safe working environment. Includes safety training and teaching orientation. Required for certification in the ACS chemistry/education option.

Credit: 2.0

Lec-Rec-Lab: (0-0-4)

Semesters Offered: Fall, Spring

Restrictions: Permission of instructor required; May not be enrolled in one of the following Course(s): Chemistry, Chemical Engineering

CH 3500 - Physical Chemistry for Environmental and Life Sciences

Equilibrium thermodynamics, chemical kinetics, transport properties, gas laws, and phase equilibria with an emphasis on solution behavior and applications to molecules important in the environmental and life sciences.

Credit: 2.0

Lec-Rec-Lab: (2-0-4)

Semesters Offered: Fall

Restrictions: May not be enrolled in one of the following Course(s): Chemistry, Chemical Engineering

Pre-Requisite(s): CH 1120 or CH 1122 or CH 1140 or (CH 1160 and CH 1161) and MA 2160

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.

Credit: 3.0

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

Semesters Offered: Fall, Spring, Summer

Pre-Requisite(s): CH 1120 or CH 1122 or (CH 1160 and CH 1161) and MA 2160

CH 3511 - Physical Chemistry Lab I

Laboratory to supplement CH3510.

Credit: 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.

Credit: 3.0

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

Semesters Offered: Spring

Pre-Requisite(s): CH 1120 or 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.

Credit: 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.

Credit: 3.0

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

Semesters Offered: Spring

Pre-Requisite(s): (BL 1020 or BL 1040) and CH 1120 or 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.

Credit: 2.0

Lec-Rec-Lab: (0-0-4)

Semesters Offered: Spring

Co-Requisite(s): CH 3540

CH 4110 - Pharmaceutical Chemistry I: 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.

Credit: 3.0

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

Semesters Offered: Spring

Restrictions: May not be enrolled in one of the following Course(s): BL 4010 or CH 4710

CH 4120 - Pharmaceutical Chemistry II: 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.

Credit: 3.0

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

Semesters Offered: Fall

Restrictions: May not be enrolled in one of the following Course(s): Freshman

Pre-Requisite(s): CH 4110

CH 4190 - Current Topics in Pharmaceutical Chemistry

Discussion of recent topics in pharmaceutical chemistry.

Credit: 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 Course(s): Freshman

CH 4210 - Instrumental Analysis

The lecture portion of CH4212; not open to undergraduate chemistry majors.

Credit: 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.

Credit: 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 - Introduction to Quantitative and Instrumental Analysis

Measurements and calculations relevant to volumetric and gravimetric techniques. Error analysis and statistical treatment of data. Basic chemical instrumentation applied to organic and inorganic analysis with emphasis on chromatography and spectroscopy.

Credit: 5.0

Lec-Rec-Lab: (3-0-6)

Semesters Offered: Spring

Restrictions: Permission of instructor required; May not be enrolled in one of the following Course(s): Cheminformatics, Chemistry; May not be enrolled in one of the following Course(s): Freshman

Pre-Requisite(s): (CH 1122 or CH 1160 and CH 1161) and CH 3510(C) and CH 3511(C)

CH 4230 - Solutions and pH

Laboratory-intensive course offered by arrangement. Students will learn proper solution preparation techniques. Acid-base equilibrium calculations will be introduced and buffer solutions prepared. Chemical safety will be integrated into all aspects of this course.

Credit: 1.0

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall

Restrictions: Permission of department required

Pre-Requisite(s): CH 1120 or CH 1122 or (CH 1160 and CH 1161)

CH 4231 - Introduction to Spectroscopy

Laboratory-intensive course offered by arrangement. Students will learn how to recognize compounds suitable for spectroscopic analysis. Sample preparation, calibration methods, and chemical safety will be emphasized. An introduction to spectroscopic instrumentation will also be given.

Credit: 1.0

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall

Restrictions: Permission of department required

Pre-Requisite(s): CH 1120 or CH 1122 or (CH 1160 and CH 1161)
CH 4232 - Introduction to Gas Chromatography
Laboratory-intensive course offered by arrangement. Students will learn how to recognize compounds suitable for gas chromatographic analysis. Sample preparation and quantitative analysis will be emphasized. An introduction to GC instrumentation will also be given.
Credits: 1.0
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall
Restrictions: Permission of department required
Pre-Requisite(s): CH 1120 or CH 1122 or (CH 1160 and CH 1161)

CH 4233 - Introduction to Liquid Chromatography
Laboratory-intensive course offered by arrangement. Students will learn how to recognize compounds suitable for liquid chromatographic analysis. Sample preparation and quantitative analysis will be emphasized. An introduction to LC instrumentation will also be given.
Credits: 1.0
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall
Restrictions: Permission of department required
Pre-Requisite(s): CH 1120 or CH 1122 or (CH 1160 and CH 1161)

CH 4272 - Process Analytical Chemistry
Hands-on introduction to the application of modern analytical chemistry in the process industries. Presents the fundamentals, use, and limitations of instruments used for process analytical measurements as well as safety regulations and hazard classifications. Emphasizes theory and practical aspects of process sampling.
Credits: 4.0
Lec-Rec-Lab: (0-2-6)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): CH 3511

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
Study of the bonding, physical and chemical properties, structure and reactions of the chemical elements and their compounds. Examples will include both transition metals and main group elements.
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 syntheses, manipulations, and methods of analyses.
Credits: 2.0
Lec-Rec-Lab: (0-0-4)
Semesters Offered: Fall
Pre-Requisite(s): CH 4310(C)

CH 4320 - Inorganic Chemistry II
Continuation of CH4310. A survey course that continues the study of the general principles of inorganic chemistry and the chemistry of the elements and their compounds.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Pre-Requisite(s): CH 4310

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. Includes use of modern software, including NMR spectromodelling, data handling and presentation, and spectral database packages.
Credits: 3.0
Lec-Rec-Lab: (2-0-3)
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 heteraromatic 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: Fall, Spring
Pre-Requisite(s): CH 2420

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 4510 - Intermediate Physical 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

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: 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 and CH 3520(C)) or (CE 4501 and CE 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): CE 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
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 1120 or CH 1122 or (CH 1160 and CH 1161)

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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, Spring
Pre-Requisite(s): CH 2400 or 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)

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 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
Pre-Requisite(s): CH 2420

CH 4720 - Biomolecular Chemistry II
Focuses on structural and chemical logic of bioprocesses with emphasis on bioorganic mechanisms and the interconnections between biology and chemistry. Bioorganic mechanisms and biophysical concepts in biochemistry 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: Spring
Restrictions: Permission of instructor required; May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): BL 4010 or CH 4710

CH 4721 - Research Methods in Biomolecular Chemistry
Lab course will emphasize the research process in biomolecular chemistry by actively involving students in question formulation, experimental design, data gathering, critical analysis, team work, and communication in an inquiry-based format. Students will employ methods used in modern biochemistry/molecular biology in a series of open-ended experiments that will lead to a student-developed original research project.
Credits: 3.0
Lec-Rec-Lab: (1-0-5)
Semesters Offered: Spring
Pre-Requisite(s): (CH 4710 and CH 4222) or CH 4212

CH 4790 - Current Topics in Biochemistry
Discussion of recent topics in biochemistry.
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 4800 - 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 department required

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
Pre-Requisite(s): (CH 2420 and CH 2421) or (CH 2400 and CH 2411) and CH 3020

CH 4900 - Senior Seminar in Chemistry I
Discussion of various topics relevant for professional development.
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall, 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

CH 4910 - Senior Seminar in Chemistry II
Discussion of various topics relevant for professional development. Includes preparation of abstracts and reports. Presentation of results of undergraduate research project or assigned library topic in written and oral form.
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
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

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 department required

CH 4995 - Undergrad Research in Biochem
Undergraduate research experience in Biochemistry where students work in independent research project under the direction of a faculty advisor.
Credits: variable to 6.0; Repeatable to a Max of 12
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required

CH 5210 - Analytical Separations
Covers theory and applications of modern gas chromatography, high performance liquid chromatography, and ion chromatography as well as instrumentation for these techniques. Studies trace organic analysis and environmental 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, Junior

CH 5230 - Mass Spectrometry and Fluorescence
Fundamentals and applications of gas chromatography-mass spectrometry, liquid chromatography-mass spectrometry and fluorescence spectroscopy.
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

CH 5310 - Advanced Inorganic Chemistry
Covers the organometallic chemistry of the transition elements, beginning with a historical overview of the subject, as well as basic ideas in complex and transition metal chemistry.
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

CH 5410 - Advanced Organic Chemistry I
Advanced study of mechanistic organic and physical organic chemistry intended to bring the student to the level of current research activity. Topics may include methods for determining organic reaction mechanisms, chemical bonding as it applies to organic compounds, structure-reactivity relationships, molecular rearrangements, and molecular orbital theory.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Level(s): Graduate

CH 5420 - Advanced Organic Chemistry II
Advanced study of organic reactions and synthetic organic chemistry intended to bring the student to the level of current research activity. Topics may include retrosynthetic analysis and synthesis design, synths, protecting groups, and analysis of syntheses from recent literature.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate
CH 5509 - 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 2005-2006 academic year
Pre-Requisite(s): CE 4501 or CH 3510
CH 5510 - Classical and Statistical Thermodynamics
Principles of classical chemical thermodynamics from the viewpoint of Gibbs and DeDonder; principles of applications of statistical mechanics to thermodynamics, including the properties of gases, liquids, electrolytic solutions, solutions of high polymers, and other systems of chemical interest.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: On Demand
Pre-Requisite(s): CH 3520
CH 5515 - 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: On Demand
Pre-Requisite(s): CH 3520 or CE 4501
CH 5520 - Chemical Kinetics
An advanced study of chemical reaction rates, including methods of analysis of reaction rate data and the theory of rate processes.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: On Demand
Pre-Requisite(s): CH 3520
CH 5530 - Molecular Spectroscopy
An introduction to molecular spectroscopy and molecular structure. Topics include infrared and Raman spectroscopy, electronic spectroscopy, fluorescence, phosphorescence, and resonance techniques.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: On Demand
Pre-Requisite(s): CH 3520
CH 5540 - Applications of Group Theory in Chemistry
The predictive power of group theory in chemistry is developed through theory and detailed applications. Emphasizes group theoretical applications to molecular orbital theory, orbital symmetry, ligand field theory, and vibrational spectroscopy.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: On Demand
Pre-Requisite(s): CH 3520
CH 5550 - Solid State Chemistry
Introduces principles of solid state chemistry and the application to produce compounds with the desired physical and chemical properties. Discusses reactivity, preparation techniques, structure, impurity or dopant effects, phase transformations, electric and magnetic properties, and point defect chemistry.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: On Demand
Pre-Requisite(s): CH 3520
CH 5560 - 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
Pre-Requisite(s): CH 3520
CH 5570 - Advanced Biophysical Chemistry
A discussion of experimental techniques and applications of physical chemistry principles to the study of the structure, dynamics, and chemical reactions of proteins, nucleic acids, and other biopolymers.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: On Demand
Pre-Requisite(s): CH 3520
CH 5900 - Chemistry Graduate Seminar
Graduate seminar in chemistry.
Credits: 1.0; Repeatable to a Max of 2
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate
CH 5975 - Full Time Master's Research
Open to students who have successfully completed all the required courses as well as the required number of credits for the master's degree. Students in this course are involved in full-time research. Tuition for this course is charged at the graduate full-time research rate. Students enrolled in this course may not register for any other course.
Credits: 9.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate
CH 5990 - Chemistry Master Research
An original investigation in chemistry for students seeking an MS degree.
Credits: variable to 12.0; May be repeated; Graded Pass/Fail Only
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate
CH 6290 - Special Topics in Analytical Chemistry
Discussion of current research developments at an advanced level. A list of possible topics might include chromatography, magnetic resonance, surface analysis, mass spectrometry, or environmental analysis.
Credits: variable to 3.0; Repeatable to a Max of 9
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate
CH 6390 - Special Topics in Inorganic Chemistry
Discussion of recent developments in inorganic chemistry.
Credits: variable to 3.0; Repeatable to a Max of 9
Semesters Offered: On Demand
Pre-Requisite(s): CH 4320
CH 6490 - Special Topics in Organic Chemistry
Advanced study in special areas of organic chemistry. Topics could include organic synthetic methods, production and reactions of enolate ions, heterocyclic, carbohydrate, bioorganic, or free-radical chemistry.
Credits: variable to 3.0; Repeatable to a Max of 9
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate
CH 6590 - Special Topics in Physical Chemistry
A discussion of recent research developments at an advanced level. Topics could include atomic and molecular structure, kinetic theory of gases, solid-state chemistry, thermodynamics, electrochemistry, and molecular spectroscopy.
Credits: variable to 3.0; Repeatable to a Max of 9
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate
CH 6690 - Special Topics in Polymer Science
Advanced study in special areas of polymer science. Topics could include thermal analysis, polymer surface science, advanced polymerization processes, scaling laws, etc. Some topics may include a laboratory component.
Credits: variable to 3.0; Repeatable to a Max of 9
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Class(es): Freshman, Sophomore, Junior
CH 6800 - Current Topics in Graduate Chemistry
Discussion of recent topics in chemistry at a graduate level.
Credits: variable to 3.0; Repeatable to a Max of 12
Semesters Offered: On Demand
Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate
CH 6975 - Full-Time Doctoral Research
Open to students who have successfully completed all required courses as well as the comprehensive and proposal defense exams. Students in this course are involved in full-time research. Tuition for this course is charged at the graduate full-time research rate. Students enrolled in this course may not register for any other course.
Credits: 9.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-9-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

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Restrictions:
Semesters Offered:
Credits:

CH 6990 - Chemistry Doctoral Research
Laboratory research in preparation of the PhD thesis. Requires permission of the student's advisory committee and the graduate faculty.
Credits: variable to 12.0; May be repeated; Graded Pass/Fail Only
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate

Chemical Engineering

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 1100 or CH 1110 or 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 stage wise 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 PH 2200

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 (MA 3520 or MA 3521 or MA 3530 or MA 3560)

CM 3215 - Fundamentals of Chemical Engineering 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.
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 enthalphy 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

CM 3410 - Tech Comm for Chem Engg
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 2001 and UN 2002

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 3110 and CM 3230(C) and (MA 3520 or MA 3521 or MA 3530 or MA 3560)

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: (2-0-1)
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 1100 or CH 1110 or CH 1112 or (CH 1150 and CH 1151)

CM 3977 - Fundamentals of Hydrogen as an Energy Carrier
This course provides an overview of traditional and alternative energy sources, with particular emphasis on hydrogen energy. Discussion of energy production and sources; electric and hydrogen vehicles; production, distribution, and policy of hydrogen, and the hydrogen economy.
Credits: 1.0
Lec-Rec-Lab: (1-0-0)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): CH 1100 or CH 1110 or CH 1112 or (CH 1150 and CH 1151) and PH 2200

CM 3978 - Hydrogen Measurements Lab
This course provides an introduction to basic experiments and measurements that relate to hydrogen and hydrogen powered fuel cells. Includes chemical and electrical safety, fuel cell operation and introduction to fuel cell integration into practical applications.
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
Pre-Requisite(s): CH 1100 or CH 1110 or (CH 1150 and CH 1151) and PH 2200
CM 4000 - Chemical Engineering Research
Student undertakes a problem in some phase of chemical engineering, reviews the literature, obtains experimental data, and submits a report.
Credits: variable to 3.0; Repeatable to a Max of 9
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required

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
Pre-Requisite(s): CM 3120 and CM 3215 and CM 3230 and CM 3410 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
Pre-Requisite(s): CM 3215 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 4450 - Computational Methods in Chemical Engineering
Computational methods for solution of chemical engineering problems in transport phenomena, reaction kinetics, and dynamical systems. Topics include general numerical methods and solution to ordinary and partial differential equations. Advanced use of MATLAB and Comsol Multiphysics software.
Credits: 2.0
Lec-Rec-Lab: (1-0-1)
Semesters Offered: Fall - Offered alternate years beginning with the 2008-2009 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): CM 3110(C) and (MA 3520 or MA 3521 or MA 3530 or MA 3560)

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, ﬂocculaton, and dispersion.
Credits: 4.0
Lec-Rec-Lab: (3-0-3)
Semesters Offered: Fall, Spring - Offered alternate years beginning with the 2005-2006 academic year

CM 4550 - Industrial Chemical Production
Integration of chemical engineering and chemistry as practiced in modern industry. Engineering of chemical reactions and processes for commodity chemicals, petroleum-based fuels, petrochemicals, intermediates, specialty chemicals, pharmaceuticals, and engineered materials. Environmental strategies for waste minimization and pollution prevention.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: On Demand
Pre-Requisite(s): (CH 2400 or CH 2410) and CM 3510(C)

CM 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 1120 or 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 2400 or 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)

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 3101 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)

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 4610(C) or CH 4610(C) or CM 4650(C)

CM 4740 - Hydrometallurgy/Pyrometallurgy
Extracting metal from ores by aqueous chemical techniques. The unit processes and unit operations in the dissolution, solubility, aqueous chemistry, concentrating and purifying metal-bearing solutions, and recovery of metals by precipitation and electrolytic processing will be discussed.
Credits: 4.0
Lec-Rec-Lab: (4-0-0)
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, Sophomore
Pre-Requisite(s): CH 1120 or CH 1122 or (CH 1160 and CH 1161)

CM 4855 - CM Process Analysis & Design I
Technical and economic evaluation of chemical processes and operations. Applies material and energy balances, ﬂowsheets, energy utilization, and optimization to process systems. Requires use of cost estimating and economic evaluation techniques. The optimization project requires a series of memorandum progress reports, a formal ﬁnal report, and an oral presentation.
Credits: 3.0
Lec-Rec-Lab: (2-0-3)
Semesters Offered: Fall
Pre-Requisite(s): CM 3120 and CM 3230 and CM 3410
CM 4860 - CM Process Analysis & Design 2
Applies technical and economical techniques to the development of a chemical process into an optimized design. Uses process synthesis techniques and market research to develop a conceptual design for a proposed new venture.
The AIChE National Design Problem is required of each student as a capstone experience.
Credits: 2.0
Lec-Rec-Lab: (2-0-0)
Semesters Offered: Spring
Pre-Requisite(s): CM 4855

CM 4861 - CM Design Laboratory 2
Discusses open-ended problems in chemical engineering design.
Credits: 1.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Spring
Pre-Requisite(s): CM 4860(C)

CM 4900 - Interdisciplinary Design 1
Focuses on an interdisciplinary chemical engineering design project. (Senior project ready as defined by major substitutes for prerequisites)
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Restrictions: Permission of department required; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

CM 4910 - Interdisciplinary Design 2
Focuses on an interdisciplinary chemical engineering design project. (Senior project ready as defined by major substitutes for prerequisites)
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Restrictions: Permission of department required; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

CM 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

CM 5100 - Appl Mathematics for CM
The solution to basic equations for momentum, mass, and heat transfer by use of separation of variables, numerical methods, and other mathematical techniques.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Level(s): Graduate

CM 5200 - Advanced CM Thermodynamics
Emphasis in phase equilibria and related concepts, such as molecular or statistical thermodynamics, nonideal fluids and solids.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Level(s): Graduate

CM 5300 - Advanced Transport Phenomena
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): CM 5100

CM 5310 - Laboratory Safety
Provides the technical and cultural background necessary to operate and manage a safe Laboratory.
Credits: 1.0
Lec-Rec-Lab: (1-0-0)
Semesters Offered: Fall

CM 5400 - Adv Reactive Systems Analysis
An analytical study of various aspects of chemical reactor behavior, such as multiple steady-states, dynamics, stability, and control. Also covers transport phenomena in packed beds of solids and mathematical modeling of packed-bed reactors.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate

CM 5500 - Theory and Methods of Research
Discusses modern methods of research. Topics could include statistical analysis, presentation of data, modern experimental methods, or oral presentation skills.
Credits: 2.0
Lec-Rec-Lab: (1-0-2)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Level(s): Graduate

CM 5720 - Advanced Mineral Processing
Topics in mineral processing of current interest. Will cover grinding, flotation, agglomeration, pollution prevention, surface chemistry, and other areas where rapid advancement is occurring.
Credits: variable to 3.0; Repeatable to a Max of 12
Semesters Offered: On Demand
Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

CM 5900 - Special Topics in CM
A discussion of chemical engineering topics of current interest not included in regular graduate courses.
Credits: variable to 3.0
Semesters Offered: On Demand
Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

CM 5950 - Advanced Special Projects
This is a course for graduate students who wish to do extensive work on projects or topics not directly related to their thesis topic and not covered in one of the graduate courses.
Credits: 3.0; Repeatable to a Max of 9
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

CM 5975 - Full Time Master's Research
Open to students who have successfully completed all the required courses as well as the required number of credits for the master's degree. Students in this course are involved in full-time research. Tuition for this course is charged at the graduate full-time research rate. Students enrolled in this course may not register for any other course.
Credits: 9.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-9-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

CM 5990 - MS Research
An original investigation of a chemical engineering problem.
Credits: 15.0; May be repeated; Graded Pass/Fail Only
Semesters Offered: Fall, Spring, Summer

CM 6975 - Full-Time Doctoral Research
Open to students who have successfully completed all required courses as well as the comprehensive and proposal defense exams. Students in this course are involved in full-time research. Tuition for this course is charged at the graduate full-time research rate. Students enrolled in this course may not register for any other course.
Credits: 9.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-9-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

CM 6990 - Doctoral Research
An original investigation in theoretical or applied chemical engineering or both, and submission of a dissertation in partial fulfillment of the requirements for the PhD degree.
Credits: variable to 12.0; May be repeated; Graded Pass/Fail Only
Semesters Offered: Fall, Spring, Summer

Construction Management

CMG 1000 - Introduction to Construction Management
Introduction to the construction management profession, current issues and trends in residential and commercial construction industries. Focuses on developing problem-solving skills, construction computational skills, verbal, written, and graphical communication skills.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Class(es): Freshman, Sophomore

CMG 1000 - Introduction to Construction Management
Introduction to the construction management profession, current issues and trends in residential and commercial construction industries. Focuses on developing problem-solving skills, construction computational skills, verbal, written, and graphical communication skills.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Class(es): Freshman, Sophomore
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 2110 - 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: Spring
Pre-Requisite(s): PH 1140 or PH 1240

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 calculation 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: Fall
Pre-Requisite(s): CMG 1140 and CMG 2120

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: (0-3-0)
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
Land development methods including site analysis, survey layout, alignment and control, earthwork, sewers, storm water, and underground utilities. Includes design project.
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 2150

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 ENG 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): Junior, Senior

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
A study of planning and scheduling techniques, network diagrams, CPM calculations, construction schedules, and project cash flow. Time schedules for materials, labor, and equipment are evaluated. Integrates the use of computer software as a scheduling tool.
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): CMG 3265

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: On Demand
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): BA 2500

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, jobsite 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

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: Spring
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): BA 2330 and EC 3400

CMG 4400 - Construction Safety Management
Focuses on the needs of modern construction professionals and on the requirements set forth by OSHA and other regulatory agencies relating specifically to construction.
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

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. Class will be in seminar format incorporating multiple texts.
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 2110 or CMG 2140

CMG 4900 - Construction Project Simulation
Capstone course. Integrates all aspects of the construction management process. Students will explore the responsibilities of the construction manager and consider project management issues through a semester-long simulated construction project (residential, commercial, or design-build). Includes oral and written report components.
Credits: 4.0
Lec-Rec-Lab: (0-3-2)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Major(s): Construction Management; Must be enrolled in one of the following Class(es): Senior
Pre-Requisite(s): CMG 3200 and CMG 3250 and CMG 4120 and CMG 4210 and HU 3120
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
Restrictions: Must be enrolled in one of the following Class(es): Engineering, Computer Science, Computer Systems Science, Computer Engineering, Electrical Engineering, Electrical Engineering.

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 1121 - Introduction to Computer Science 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
Pre-Requisite(s): MA 1031(C) or MA 1032(C)

CS 1122 - Introduction to Computer Science II
Continuation of CS 1121. Topics include data abstraction, class hierarchies and polymorphism, list, stack and queue data structures, informal complexity-based algorithm and data structure choices, and recursion. Homework programming assignments are given. Not open to students with credit in CS 1122.
Credits: 2.0
Lec-Rec-Lab: (0-2-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): CS 1121

CS 1219 - Introduction to Computer Science II in C++
Continuation of CS 1121. Topics include data abstraction, class hierarchies and polymorphism, list, stack and queue data structures, informal complexity-based algorithm and data structure choices, and recursion. The C and C++ programming languages are presented and uses. Not open to students with credit in CS 1122.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Restrictions: May not be enrolled in one of the following Major(s): Software Engineering, Computer Systems Science, Computer Engineering, Computer Science
Pre-Requisite(s): CS 1121

CS 1311 - Computer Science I
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: 4.0
Lec-Rec-Lab: (0-4-0)
Semesters Offered: Fall, Spring
Restrictions: Permission of department required
Pre-Requisite(s): MA 1031 or MA 1032

CS 1721 - Object Oriented Design
Principles of object oriented design. Includes the software life cycle and unit testing. Students are required to design, unit test, implement, and final test a relatively large project.
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): CS 1121 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 2141 - Software Development Methods Using C/C++
This course provides an accelerated coverage of C/C++ for Java programmers. Topics include object oriented design with UML, object oriented programming with C++, C/C++ memory model, differences between C and C++ use of libraries, and debugging with modern tools.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): CS 1721 and CS 2321

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 1122 or CS 1131) and (MA 1135 or MA 1160 or MA 1161)

CS 2321 - Data Structures
Presents fundamental concepts in data structures. Topics include ADTs (trees, priority queues, dictionaries and graphs) and their implementations, algorithm analysis, sorting and text processing. Programming projects are designed to apply these topics.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): CS 1122 or CS 1131

CS 2390 - 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
Introduction to the development of large software projects. Presents examples of software design, quality assurance techniques, and test-case design in conjunction with a significant team project involving design, test, and code documentation as well as user documentation. Other topics include teamwork, user interfaces, and professional responsibility.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): CS 2141 and CS 2311
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
Pre-Requisite(s): CS 2311

CS 3411 - Compiler Construction
Introduction to compilation techniques, including parsing, syntax-directed translation, run-time storage management, error recovery, code generation and optimization. Requires a significant project.

Credits: 4.0
Lec-Rec-Lab: (0-3-1)
Semesters Offered: Spring
Pre-Requisite(s): CS 4121

CS 3411 - Introduction to Computation Theory
Provides deeper insight into the power of computing using various models of computation. Topics reviewed include proof techniques, finite automata, regular languages, pushdown automata, and context-free languages. Topics covered include Turing machines and their variants, the Halting Problem and decidability, Rice's theorem, computability, time complexity, reducibility, NP-completeness, space complexity, machine self reference, recursion and fixed point theorems, s-m-n theorem.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): CS 3311

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
Pre-Requisite(s): CS 2141 and CS 3421

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: (0-3-3)
Semesters Offered: Fall
Pre-Requisite(s): CS 3411(C) or CS 4411(C)

CS 3911 - Introduction to Numerical Methods with FORTRAN
Topics include floating point arithmetic, sources of numerical error, Taylor polynomials, solution of linear systems and nonlinear equations, interpolation, numerical integration, and numerical solution of differential equations. FORTRAN 90 topics include data types, control flow, arrays, procedures, pointers and dynamic data structures, I/O, and modules. Numerical algorithms will be coded.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): CS 3411(C) or CS 4411(C)

CS 4000 - Senior Seminar
Topics include ethical models, legal issues, privacy and security, social responsibility, professional responsibility and service, and the future of computing.

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-Requisite(s): CS 3141

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 2141 and CS 3311 and CS 3421

CS 4411 - Introduction to Operating Systems
Presents topics on program representation and execution, operating systems, process and threads, process scheduling, memory management, and file systems. Programming homework is required.

Credits: 4.0
Lec-Rec-Lab: (0-3-1)
Semesters Offered: Fall, Spring
Pre-Requisite(s): CS 2141 and CS 3421

CS 4421 - Database Systems
Topics include goals of database management; data definition; data models; data normalization; data retrieval and manipulation; security, integrity, and privacy measures; file, data, and storage organization; object-database systems; and parallel and distributed databases. Surveys a number of general database systems and examines in detail at least one database system.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): CS 4411 or CS 4321

CS 4431 - Computer Architecture
Architecture of high-performance parallel computer systems. Introduces various forms of parallelism, such as multiple functional units, pipelining, multiprocessors, and processor arrays. Also covers interleaved memory, caching, and interconnection networks. Includes analytic and simulation models of architectural features that implement or support parallel processing.

Credits: 4.0
Lec-Rec-Lab: (0-3-3)
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.

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 and to network tools and programming.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): CS 4321 and CS 4411

CS 4471 - Computer and Network Security
Development of administration of secure software systems. Topics include principles of software development, practical cryptography, program security, operating system security, network 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 4481 - Computer and Network Performance Analysis
Analysis of the performance of computer systems. Topics include measurement techniques and tools, probability theory and statistics, experiment design and analysis, simulation, queuing models. Course includes a significant experimental component.
Credits: 4.0
Lec-Rec-Lab: (0-3-3)
Semesters Offered: Spring
Pre-Requisite(s): MA 2720 and CS 4411

Introduction to interactive computer graphics. Topics include graphics terminology, 3D viewing, 3D transformation, interactive techniques, use of graphics input devices, projections, modeling, lighting, texturing, evaluators, and graphics algorithms. Requires substantial programming homework.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): CS 2141

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
Pre-Requisite(s): CS 3141

CS 4791 - Senior Software Engineering Project I
A capstone project course. Using software engineering principles and techniques, students work as part of a team responsible for developing a quality software project.
Credits: 3.0
Lec-Rec-Lab: (0-1-4)
Semesters Offered: On Demand
Restrictions: Permission of instructor required
Pre-Requisite(s): CS 4710 or CS 4711 or CS 4712

CS 4792 - Senior Software Engineering Project II
A continuation of the capstone project experience, intended for Software Engineering majors.
Credits: 3.0
Lec-Rec-Lab: (0-1-4)
Semesters Offered: Fall, Spring
Restrictions: Permission of instructor required
Pre-Requisite(s): CS 4791

CS 4811 - Artificial Intelligence
Fundamental ideas and techniques that are used in the construction of problem solvers that use AI technology. Topics include knowledge representation and reasoning, problem solving, heuristics, search heuristics, inference mechanisms, and machine learning.
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): CS 1721 and CS 2321 and CS 3311

CS 5090 - 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: Fall, Spring, Summer
Restrictions: Permission of department required

CS 5091 - Graduate Seminar in Computer Science
From time to time, depending on student demand, a seminar will be offered on advanced topics in current computer science research.
Credits: variable to 3.0; May be repeated; Graded Pass/Fail Only
Semesters Offered: On Demand
Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

CS 5131 - Compiler Optimization
This course emphasizes the design and implementation of low- and high-level compiler optimizations. Topics include instruction-level optimization, traditional compiler optimization, global register allocation, instruction scheduling, dependence analysis, memory-reuse analysis and loop transformations.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): CS 4131

CS 5311 - Theory of Computation
Topics covered include Turing machines and their variants, the halting problem and decidability, computability, reducibility, NP-completeness, time and space complexity, and topics from recursive function theory. The course starts with a brief review of the computation models from CS3311.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): CS 4321

CS 5321 - Advanced Algorithms
Design and analysis of advanced algorithms. Topics include algorithms for complex data structures, probabilistic analysis, amortized analysis, approximation algorithms, and NP-completeness. Design and analysis of algorithms for string-matching and computational geometry are also covered.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Pre-Requisite(s): CS 3311

CS 5331 - Parallel Algorithms
Advanced topics in the design, analysis, and performance evaluation of parallel algorithms. Topics include advanced techniques for algorithm analysis, memory models, run time systems, parallel architectures, and program design, particularly emphasizing the interactions of these factors.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): CS 4431 and CS 4331
CS 5411 - Advanced Operating Systems
Advanced concepts in operating systems. Topics include real-time and multiprocessor scheduling, I/O, modern file systems, and performance analysis. Also requires a substantial implementation project.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): CS 4411

CS 5431 - Advanced Computer Architecture
An in-depth study of several aspects of parallel processing, with an emphasis on parallel architectures. The course has an analytical focus and investigates models of various aspects of the design and analysis of parallel systems. Topics include simple unprocessor/multiprocessor performance models, pipelining, instruction-level parallelism, and multiprocessor design issues.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): CS 4431

CS 5441 - Distributed Systems
Covers time and order in distributed systems; mutual exclusion, agreement, elections, and atomic transactions; Distributed File Systems, Distributed Shared Memory, Distributed System Security; and issues in programming distributed systems. Uses selected case studies.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): CS 4461

CS 5461 - Mobile Networks
Mobile network issues including routing and mobility management strategies in ad hoc networks, sensor networks, and personal area networks such as Bluetooth.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): CS 4611

CS 5611 - Computer Graphics: Advanced Rendering and Animation
Topics include polygonal objects, parametric curves and surfaces, lighting models, shadows and textures, ray-tracing techniques, radiosity methods, volume rendering, and animation.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): CS 4611

CS 5780 - Human-Computer Interactions and Usability Testing
Current issues in human-computer interaction (HCI), evaluation of user interface (UI) design, and usability testing of UI. Course requires documenting UI design evaluation, UI testing, and writing and presenting a HCI survey, concept or topic paper.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): CS 4760

CS 5811 - Advanced Artificial Intelligence
Course topics include current topics in artificial intelligence including agent-based systems, learning, planning, use of uncertainty in problem solving, reasoning, and belief systems.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): CS 4811

CS 5975 - Full Time Master’s Research
Open to students who have successfully completed all the required courses as well as the required number of credits for the master’s degree. Students in this course are involved in full-time research. Tuition for this course is charged at the graduate full-time research rate. Students enrolled in this course may not register for any other course.
Credits: 9.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

CS 5990 - Master's Research in Computer Science
The study of an acceptable computer science problem and the preparation of a thesis.
Credits: variable to 9.0; Repeatable to a Max of 99; Graded Pass/Fail Only
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

CS 5999 - Master's Reading and Research in Computer Science
Individual reading and research on current topics in computer science.
Credits: variable to 9.0; May be repeated
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

CS 6090 - 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: Fall, Spring, Summer
Restrictions: Permission of department required

CS 6091 - Doctoral Seminar in Computer Science
Seminar covers advanced topics in current Computer Science research for doctoral degree candidates. Offered according to student demand.
Credits: variable to 3.0; May be repeated
Semesters Offered: On Demand
Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

CS 6461 - Advanced Computer Networks
Students will perform a full cycle of typical research activities on selected advanced research topics in networking, including literature survey, problem formulation, giving assumptions, providing a solution, providing a plan of evaluation, and presentation of results.
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): CS 4461

CS 6975 - Full-Time Doctoral Research
Open to students who have successfully completed all required courses as well as the comprehensive and proposal defense exams. Students in this course are involved in full-time research. Tuition for this course is charged at the graduate full-time research rate. Students enrolled in this course may not register for any other course.
Credits: 9.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-9-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

CS 6990 - Doctoral Research in Computer Science
The study of an acceptable computer science problem and the preparation of a dissertation.
Credits: variable to 9.0; May be repeated; Graded Pass/Fail Only
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

CS 6999 - Doctoral Reading and Research in Computer Science
Individual reading and research on current topics in Computer Science for doctoral degree candidates.
Credits: variable to 9.0; May be repeated
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

Computational Science & Engr

CSE 5091 - Computational Science and Engineering Seminar
From time to time, depending on student demand, a seminar will be offered on current topics in computational science and engineering.
Credits: variable to 3.0; May be repeated
Semesters Offered: Fall, Spring
Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

CSE 5311 - Theory of Computation
Topics covered include Turing machines and their variants, the halting problem and decidability, computability, reducibility, NP-completeness, time and space complexity, and topics from recursive function theory. The course starts with a brief review of the computation models from CS3311.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): CS 3311
CSE 5321 - Advanced Algorithms
Topics include algorithms for complex data structures, amortized analysis, and NP-completeness. Application areas include approximation algorithms, network flow, combinatorics, string matching, and parallel algorithms. Additional topics as time permits.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): CS 4321

CSE 5331 - Parallel Algorithms
Emphasizes the principles used in the development of algorithms for parallel computers, including programming paradigms, implementation, analysis, and performance evaluation. Considers algorithms in the areas of scientific computation and nonnumeric processing as well as software tools for performance visualization and debugging.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): CS 4321 and CS 4431

CSE 5710 - Modeling and Simulation Applications for Decision-Making in Complex Dynamic Domains
Introduces students to the theory and application of modeling techniques and simulations in the analysis of decision alternatives. Topics include queueing theory, system dynamics modeling, agent based modeling, and discrete event simulation. Students conceptualize and implement an appropriate research/engineering problem of choice (this could be a dissertation/thesis problem).
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): CS 4321 and CS 4431

CSE 5720 - Descriptive Modeling of Data using Statistical and Graphical Methods
Focuses on the fundamentals of probability theory and graph theory and how relevant concepts apply to describe, model, and analyze data sets. Topics include probability distributions, Bayes theorem, conditional independence, discrete and continuous models, regression models, hypothesis testing, and Markov chain methods.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate

CSE 5811 - Advanced Artificial Intelligence
Current topics in artificial intelligence including agent-based systems, learning, planning, use of uncertainty in problem solving, reasoning, and belief systems.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): CS 4811

CSE 6090 - Special Topics in Computational Science and Engineering
Special topics in Computational Science and Engineering offered on occasion based on student and faculty demand and interest.
Credits: variable to 4.0; May be repeated
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required

CSE 6091 - Computational Science and Engineering Seminar
From time to time, depending on student demand, a seminar will be offered on current topics in computational science and engineering.
Credits: variable to 3.0; May be repeated
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

CSE 6975 - Full-Time Doctoral Research
Open to students who have successfully completed all required courses as well as the comprehensive and proposal defense exams. Students in this course are involved in full-time research. Tuition for this course is charged at the graduate full-time research rate. Students enrolled in this course may not register for any other course.
Credits: 9.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

CSE 6990 - Doctoral Research
By arrangement with the instructor directing the PhD dissertation.
Credits: variable to 9.0; May be repeated; Graded Pass/Fail Only
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

CSE 6999 - Doctoral Reading and Research
Individual reading and research on current topics in computational science and engineering.
Credits: variable to 9.0; May be repeated
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

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
Analysis of rational choices by consumers and producers and how these choices affect the allocation of resources and the distribution of income in a market economy. Topics include strategic interaction, uncertainty, prices, and market structure.
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)

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)

EC 3202 - History of Economic Thought
Development of economic ideas from the mercantilists and physiocrats through modern supply side economics, including economists such as Smith, Ricardo, Marx, Keynes, Mill, and Friedman.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: On Demand
Pre-Requisite(s): EC 2001

EC 3300 - Game Theory/Strategic Behavior
The study of strategic situations involving the interactions of individuals. Modeling techniques are applied to game situations faced in business, entertainment, politics, and the daily routine of life.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Summer - Offered alternate years beginning with the 2000-2001 academic year
Pre-Requisite(s): EC 2001

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

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

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 College(s): School of Business & Economics; May not be enrolled in one of the following Class(es): Freshman, Sophomore
EC 3500 - 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, Spring - Offered alternate years beginning with the 2001-2002 academic year
Pre-Requisite(s): EC 2001

EC 3700 - 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 - Offered alternate years beginning with the 2001-2002 academic year
Pre-Requisite(s): EC 2001 and (BA 2100 or MA 2710 or MA 2720 or MA 3710)

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: (0-3-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Major(s): Economics; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

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: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): (EC 2001 or EC 3002 or EC 3003) and (BA 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: Spring
Pre-Requisite(s): EC 3003 (BA 3400)

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

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

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

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

EC 4700 - Economics of Health Care
Economic analysis of the health care sector: organization, demand and supply factors, pricing practices, financing mechanism, public vs. private, impact of third party, medical school funding and admission policy, insurance and prepayment, and health and economic development.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: On Demand
Pre-Requisite(s): EC 2001

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 4990 - 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

EC 5000 - Microeconomics
Credits: 4.0
Lec-Rec-Lab: (0-4-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): EC 3002

EC 5010 - Macroeconomics
The study of the determinants of the level of income, employment, the rate of inflation, economic growth, and cyclical variations in the economy, including considerations of the rationale for monetary and fiscal policy and their impact on the business community.
Credits: 4.0
Lec-Rec-Lab: (0-4-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): EC 3003

EC 5300 - Managerial Economics
Economic analysis of the operation of a business. Topics include optimization, demand theory and forecasting, production/cost analysis, market structure and strategic behavior, risk analysis, antitrust policy and regulation of safety and the environment, and international management.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring, Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): EC 3003

EC 5400 - Advanced Engineering Economics
Presents and demonstrates procedures and quantitative techniques used in capital budgeting and project evaluation and selection for industry. Topics include cash flow analysis, decision methods, risk and uncertainty, cost of capital, taxes and depreciation, and forecasting market variables. Topics presented with study problems, applying spreadsheet programs.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand - Offered alternate years beginning with the 2002-2003 academic year
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): BA 3400 or EC 3400

EC 5630 - Energy Economics
Examines social and private problems in the supply, distribution, and use of energy resources and the energy industries. Studies production, allocation, and environmental and social problems of petroleum, natural gas, coal, nuclear, electricity, and various alternative energy sources.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate
Education

ED 5630 - 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. Not open to students who have credit for EC4630.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Level(s): Graduate

EC 5640 - 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. Not open to students who have credit for EC4640.

Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Pre-Requirement(s): EC 2001 or EC 3002

EC 5650 - 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. Not open to students who have credit for EC4650.

Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Pre-Requirement(s): EC 2001 or EC 3002

EC 5900 - Special Topics
Economic topics of interest to students or independent study in economics under the guidance of a faculty member.

Credits: variable to 4.0; Repeatable to a Max of 8
Semesters Offered: On Demand
Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

EC 5975 - Full Time Master's Research
Open to students who have successfully completed all the required courses as well as the required number of credits for the master's degree. Students in this course are involved in full-time research. Tuition for this course is charged at the graduate full-time research rate. Students enrolled in this course may not register for any other course.

Credits: 9.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-9-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

EC 5999 - Graduate Research
Under the guidance of a faculty member, students will read, conduct research, and prepare a report, paper, or thesis.

Credits: variable to 15.0; Repeatable to a Max of 15; Graded Pass/Fail Only
Lec-Rec-Lab: (0-15-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

EC 5999D - Graduate Research
Under the guidance of a faculty member, students will read, conduct research, and prepare a report, paper, or thesis.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

ED 3110 - 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: Fall, Spring, Summer
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

Pre-Requirement(s): PSY 2000 and UN 2002

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

Pre-Requirement(s): ED 3110, ED 3410

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

Co-Requirement(s): ED 3110, ED 3410

ED 3410 - Clinical Experience
Observation, tutoring and classroom teaching in an area school classroom. This course is one component of 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, Sophomore

Co-Requirement(s): ED 3110, ED 3210

ED 3510 - Communicating Science I
Students will learn how to design and deliver hands-on presentations to K-8 students and their parents. Presentations will be delivered at 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: 2.0
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring, Summer

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: Spring
Restrictions: Permission of department required

Pre-Requirement(s): ED 3110 and ED 3210 and ED 3410 and ED 4140

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: Restriction of department required

Pre-Requirement(s): ED 3110 and ED 3210 and ED 3410 and 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 4500 - Special Problems in Education
Literature, laboratory, or field investigation under the supervision of authorized University faculty/staff with a required report of work performed and results obtained.
Credits: variable to 6.0; Repeatable to a Max of 9
Semesters Offered: Fall, Spring

ED 4510 - Special Topics in Education
Semesters Offered:
Credits:
Restrictions:

ED 4600 - Independent Study in Education
Through independent study, gain additional insights to relevant topics in education and research. Students must work directly with select faculty to develop a structured line of study on select educational topics.
Credits: variable to 6.0; Repeatable to a Max of 9
Semesters Offered: Fall, Spring
Restrictions: Permission of instructor required

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, Junior
Pre-Requisite(s): ED 3110 and ED 3210 and ED 3410

ED 4710 - Methods of Teaching Science and Mathematics
Application of learning and instructional theories to the teaching of science and mathematics.
Credits: 3.0
Lec-Rec-Lab: (2-0-2)
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)

ED 4740 - Methods of Teaching Business
Application of learning theories and national and state standards to the teaching of business. Emphasizes methods, materials, and media used to teach adolescents. Requires admission to the teacher education program by the Department of Education.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Restrictions: Permission of department required
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 4790 - Curriculum and Methods of Teaching Health and Physical Education
A course in program planning and techniques of teaching physical education and health education in the secondary schools. Includes critical analysis of methods now in use in physical education and health education, their interrelationship and criteria for evaluation or programs. Unit planning, daily lesson plans, teaching aids, materials for the program included.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Fall
Restrictions: Permission of department required; Must be enrolled in one of the following Major(s): Health and Physical Education; Must be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): BL 3970 and EH 4420 and EH 4301 and EH 4300 and ED 4150

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: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): UN 2002

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, Junior
Pre-Requisite(s): ED 3100 and ED 4700 and (ED 4710(C) or HU 4140(C) or SS 4020(C) or ED 4740)

ED 5100 - College Teaching
Covers course preparation, educational testing and evaluation, understanding theories and processes of student learning, developing assignments, instructional strategies (discussions, lecturing, collaborative learning, cases/simulations, etc.), using instructional technologies, motivating students, the roles of the teaching assistant, and using institutional resources for student development.
Credits: 2.0
Lec-Rec-Lab: (0-2-0)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate

ED 5110 - Educational Psychology
Review of psychological principles as they relate to human learning. Covers factors in school that contribute to the emotional, psychological stability of the developing child: assessing students’ capabilities, setting educational objectives for the child, classroom practices, teaching methods, and their relationship to different types of students. All three components of the Early Block must be taken concurrently.
Credits: 2.0
Lec-Rec-Lab: (0-2-0)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate

ED 5110 - Educational Psychology
Review of psychological principles as they relate to human learning. Covers factors in school that contribute to the emotional, psychological stability of the developing child: assessing students’ capabilities, setting educational objectives for the child, classroom practices, teaching methods, and their relationship to different types of students. All three components of the Early Block must be taken concurrently.
Credits: 2.0
Lec-Rec-Lab: (0-2-0)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate

ED 5210 - Principles 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. All three components of the Early Block must be taken concurrently.
Credits: 2.0
Lec-Rec-Lab: (0-2-0)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Co-Requisite(s): ED 5110, ED 5410

ED 5310 - Graduate Seminar in Education
Introduction to contemporary issues in teacher education. Synthesis of clinical experiences with the psychological foundations of learning and foundations of education courses. Requires a term project.
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate

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ED 5410 - Educational Field Experience
Observation, tutoring and classroom teaching in an elementary school classroom. This course is one component of the Teacher Education Early Block. Requires admission to teacher education program. All three components of the Early Block need to be taken concurrently.
Credits: 1.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Co-Requisite(s): ED 5110, ED 5210

ED 5420 - Mentoring Student Teachers
Classroom mentoring, support and supervision of student teachers. Emphasis on helping student teachers improve skills in assessment, planning, classroom management.
Credits: 1.0; Repeatable to a Max of 6
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall, Spring
Restrictions: Permission of department required

ED 5500 - Special Studies in Educational Psychology
Individual or group studies of specially selected issues or problems in educational psychology. Credit may be granted for scholarly work under the supervision of departmental-approved, authorized University faculty members that results in an acceptable scholarly product: research reports, curricula, computer program, or other.
Credits: variable to 6.0; 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, Junior

ED 5510 - Special Studies in Educational Technology
Individual or group studies of specially selected issues or problems in educational technology. Credit may be granted for scholarly work under the supervision of departmental-approved, authorized University faculty members that results in an acceptable scholarly product: research reports, curricula, computer program, or other.
Credits: variable to 6.0; Repeatable to a Max of 9
Semesters Offered: On Demand
Restrictions: Permission of instructor required

ED 5520 - Special Studies in Middle and Secondary Methods
Individual or group studies of specially selected issues or problems in middle and secondary school methods. Credit may be granted for scholarly work under the supervision of departmental-approved, authorized University faculty members that results in an acceptable scholarly product: research reports, curricula, computer program, or other.
Credits: variable to 6.0; Repeatable to a Max of 9
Semesters Offered: On Demand
Restrictions: Permission of instructor required

ED 5530 - Special Studies in Elementary and Middle Methods
Individual or group studies of specially selected issues or problems in elementary and middle schools methods. Credit may be granted for scholarly work under the supervision of departmental-approved, authorized University faculty members that results in an acceptable scholarly product: research reports, curricula, computer program, or other.
Credits: variable to 6.0; Repeatable to a Max of 9
Semesters Offered: On Demand
Restrictions: Permission of instructor required

ED 5540 - Special Studies in Education I
Individual or group studies of specially selected issues or problems in education. Credit may be granted for scholarly work under the supervision of departmental-approved, authorized University faculty members that results in an acceptable scholarly product: research reports, curricula, computer program, or other.
Credits: variable to 6.0; Repeatable to a Max of 9
Semesters Offered: On Demand
Restrictions: Permission of instructor required

ED 5550 - Special Studies in Education II
Individual or group studies of specially selected issues or problems in education. Credit may be granted for scholarly work, under the supervision of departmental-approved, authorized University faculty members that results in an acceptable scholarly product: research reports, curricula, computer program, or other.
Credits: variable to 6.0; Repeatable to a Max of 9
Semesters Offered: On Demand
Restrictions: Permission of instructor required

ED 5560 - Ecology of Isle Royale for Educators
K-12 teachers participate in a field-based camping experience on Isle Royale National Park, exploring basic ecological concepts regarding the interrelatedness of plants, animals, geology, climate, and human influences on Isle Royale. Prepares teachers to help students understand interrelationships, energy distribution in ecosystems and change over time.
Credits: 3.0
Lec-Rec-Lab: (0-1-6)
Semesters Offered: Summer
Restrictions: Permission of department required
Pre-Requisite(s): ED 5561(C)

ED 5561 - Ecology of Isle Royale Practicum for Educators
Teachers will implement a one-two week teaching unit based on their experiences in ED5560 and assess its impact on learning in their classroom.
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: On Demand
Restrictions: Permission of department required
Pre-Requisite(s): ED 5560(C)

ED 5565 - Developing Algebraic Thinking
Video case studies will be used as a context for the analysis of pedagogical and mathematical issues associated with the teaching and learning of fundamental algebraic ideas. Intended for teachers at the middle and early secondary school levels.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Permission of department required

ED 5566 - Teaching Algebra: Mathematical Tasks
Examination of how the tasks used in instruction support students' understanding of algebraic ideas. Teachers will engage in the modification, design and implementation of algebraic tasks.
Credits: variable to 4.0; Repeatable to a Max of 8
Semesters Offered: Spring, Summer
Restrictions: Permission of department required

ED 5570 - Lesson Study
Teachers will engage in an intensive method of improving instruction that includes designing a lesson with a group of colleagues, implementing the lesson in one of their classrooms, and collectively examining the lesson's effectiveness in engaging students in meaningful learning.
Credits: variable to 3.0; Repeatable to a Max of 3
Semesters Offered: On Demand
Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

ED 5600 - Independent Study in Education
Through an independent study, gain additional insights to relevant topics in education and research. Students must work directly with select faculty to develop a structured line of study on select educational topics.
Credits: variable to 6.0; Repeatable to a Max of 9
Semesters Offered: On Demand
Restrictions: Permission of instructor required

ED 5601 - Special Content Studies in Education
Educators' Science and Mathematics Institute Series Courses. Intensive institutes designed to help elementary, middle and high school educators integrate important concepts in math and science into classroom teaching units. New content areas are designed each year to address the needs of participating teachers.
Credits: variable to 9.0; Repeatable to a Max of 9
Semesters Offered: Fall, Spring, Summer

ED 5602 - Special Applications in Education
Educators' Science and Mathematics Institute Series Practicums. Practical application following special content studies during which elementary, middle and high school teachers implement and evaluate a teaching unit that they designed for their own classroom inspired by the previous content course. A mandatory teachers' forum provides opportunity to share ideas with other participating teachers.
Credits: variable to 9.0; Repeatable to a Max of 9
Semesters Offered: Fall, Spring

ED 5603 - Special Topics in Education
Teachers' Earth Science Institute Courses. Utilizes mineral science and mineral processing to enhance the teaching of science in middle and high school. Teachers will be involved in hands-on, discovery-based activities that integrate concepts in math, physics, and chemistry with elements of social sciences.
Credits: variable to 9.0; Repeatable to a Max of 9
Semesters Offered: Spring, Summer

ED 5620 - Professional Development for Educators: Teaching Earth Science
A course for the professional development of professional K-12 educators. Topics address ideas, trends, and applications in the teaching and learning of earth science.
Credits: variable to 4.0; Repeatable to a Max of 12
Semesters Offered: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

ED 5621 - How the Earth Works
Teacher professional development tied to the Michigan State Standards and Benchmarks in Earth Science. The course will assist teachers from multiple science disciplines to strengthen Earth Science content and pedagogy.
Credits: 2.0
Lec-Rec-Lab: (0-2-0)
Semesters Offered: Fall
Restrictions: Permission of department required
ED 5622 - Earth Systems Science Pedagogy
This teacher professional development course will address science content, pedagogy, and personal effectiveness to ensure that teachers' pedagogy allows them to connect to the experiences of all students. Topics will include visualization tools, earth system science data sources, inquiry-based instruction, teaching for understanding, and strategies for engaging diverse and special needs learners.
Credits: 1.0; Repeatable to a Max of 6
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall, Spring
Restrictions: Permission of department required

ED 5650 - Professional Development for Educators: Teaching Life Sciences
A course for the professional development of professional K-12 educators. Topics address ideas, trends, and applications in the teaching and learning of life science.
Credits: variable to 4.0; Repeatable to a Max of 12
Semesters Offered: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

ED 5640 - Professional Development for Educators: Teaching Environmental Science
A course for the professional development of professional K-12 educators. Topics address ideas, trends, and applications in the teaching and learning of environmental science.
Credits: variable to 4.0; Repeatable to a Max of 12
Semesters Offered: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

ED 5641 - Global Change Institute for Teachers
This course will provide teachers with the skills necessary to engage middle/high school students in real-world study of global climate change and its effects on ecosystems. National Content Standards for mathematics, and life, earth, and physical sciences will be addressed.
Credits: variable to 4.0; Repeatable to a Max of 4
Semesters Offered: Summer

ED 5650 - Professional Development for Educators: Teaching Physical Science
A course for the professional development of professional K-12 educators. Topics address ideas, trends, and applications in the teaching and learning of physical science.
Credits: variable to 4.0; Repeatable to a Max of 12
Semesters Offered: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

ED 5660 - Professional Development for Educators: Teaching Mathematics
A course for the professional development of professional K-12 educators. Topics address ideas, trends, and applications in the teaching and learning of mathematics.
Credits: variable to 4.0; Repeatable to a Max of 12
Semesters Offered: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

ED 5661 - Professional Development for Educators: Teaching Mathematics through Navigation
This course will cover the theory and practice of marine navigation. Students will learn navigation techniques and procedures while solving navigation problems using mathematics, charts, basic navigation instruments and electronic instruments.
Credits: 2.0
Lec-Rec-Lab: (0-1-2)
Semesters Offered: Summer
Restrictions: Permission of department required; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

ED 5665 - Professional Development for Educators: Teaching Computer Science
A course for the professional development of professional K-12 educators. Topics address ideas, trends, and applications in the teaching and learning of computer science.
Credits: variable to 4.0; Repeatable to a Max of 12
Semesters Offered: On Demand

ED 5670 - Professional Development for Educators: Teaching Technology
A course for the professional development of professional K-12 educators. Topics address ideas, trends, and applications in the teaching and learning of technology.
Credits: variable to 4.0; Repeatable to a Max of 12
Semesters Offered: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

ED 5680 - Professional Development for Educators: Teaching Social Studies
A course for the professional development of professional K-12 educators. Topics address ideas, trends, and applications in the teaching and learning of social studies.
Credits: variable to 4.0; Repeatable to a Max of 12
Semesters Offered: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

ED 5685 - Teaching World History and Geography
Globalization is the organizing core concept of this intensive institute for secondary teachers. A thematic immersion in key topics to be covered in the required high school course on world history and geography, including the global system, empire, revolution, nationalism, industrialization, decolonization, population growth, cultural diversity, settlement, and migration. Emphasis on the Michigan High School Course Expectations for World History and Geography.
Credits: variable to 4.0; Repeatable to a Max of 8
Semesters Offered: Summer
Restrictions: Permission of department required

ED 5686 - Regional Content for World History and Geography Education
Regional content for teachers of World History and Geography focusing on China, India, Africa, Latin America, and the Middle East. Utilizes the Michigan High School Course Expectations for World History and Geography.
Credits: variable to 4.0; Repeatable to a Max of 8
Semesters Offered: Summer
Restrictions: Permission of department required

ED 5690 - Professional Development for Educators: Teaching Language Arts
A course for the professional development of professional K-12 educators. Topics address ideas, trends, and applications in the teaching and learning of language arts.
Credits: variable to 4.0; Repeatable to a Max of 12
Semesters Offered: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

ED 5695 - Professional Development for Educators: Teaching Business
A course for the professional development of professional K-12 educators. Topics address ideas, trends, and applications in the teaching and learning of business.
Credits: variable to 4.0; Repeatable to a Max of 12
Semesters Offered: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

ED 5700 - Education Research
In-depth study of education research methods pertaining to classroom practice, curriculum standards, and program evaluation. Course will include an opportunity to design research to answer questions relevant to improving science and math instruction. Equivalent to ED 5701 plus ED 5702.
Credits: 2.0
Lec-Rec-Lab: (0-2-0)
Semesters Offered: Fall

ED 5701D - Education Research Methods
Study of research methods in education. Issues of research design, program evaluation, and data presentation will be addressed.
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Class(es): Graduate

ED 5702D - Action Learning and Action Research
A form of systematic inquiry conducted by teacher researchers to gain insight into how students learn. Use of educational research projects to improve science and math teaching in secondary schools.
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Class(es): Graduate

ED 5703 - Action Research in Depth
A web-based study of education research methods linking classroom practice, curriculum standards, and program evaluation with research about learning. Teachers will learn about data presentation, action learning, and developing students into communities of science learners.
Credits: 2.0
Lec-Rec-Lab: (0-2-0)
Semesters Offered: Spring
Restrictions: Permission of department required

ED 5705 - Action Research Project
Teachers will engage in the systemic study of their own practice by designing an action research study and then collecting and analyzing data to answer a question about their own teaching and/or student learning. Course enrollment is restricted to practicing teachers.
Credits: variable to 4.0; Repeatable to a Max of 8
Semesters Offered: Summer
Restrictions: Permission of department required
ED 5730 - STEM Learning Materials, Inquiry and Assessment
Examination of learning materials that enable inquiry-based learning as prescribed by state and national standards. Assessment techniques to measure this type of learning will be considered. Equivalent to ED 5731 plus ED 5732.
Credits: 2.0
Lec-Rec-Lab: (0-2-0)
Semesters Offered: Spring
ED 5731D - STEM Learning Materials and Inquiry
Inquiry, as described by state and national standards, will serve as the focus of a survey of learning materials, particularly those that are internet-based. Identification, selection, and evaluation of source materials for teaching science.
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Class(es): Graduate
ED 5732D - Assessing STEM Learning
A survey of alternative and authentic assessment techniques for ensuring consistency, reliability, and fairness in evaluating STEM learning. Assessment planning techniques reviewed will use both national and state standards as guides to measure outcomes.
Credits: 2.0
Lec-Rec-Lab: (0-2-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): ED 5700
Restrictions: Must be enrolled in one of the following Class(es): Graduate
ED 5740 - Connecting State & National Standards with Education Research
Current research and classroom practice will be examined using state and national standards. Objective is to further understanding of how goals can promote higher levels of learning. Equivalent to ED 5741 plus ED 5742.
Credits: 2.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Spring
Pre-Requisite(s): ED 5700
Restrictions: Must be enrolled in one of the following Class(es): Graduate
ED 5741D - STEM Standards at the State and National Levels
An examination of the state STEM standards from the standpoint of national goals, standardized assessment, and classroom practice.
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Class(es): Graduate
Pre-Requisite(s): ED 5700
ED 5742D - Research Trends and Classroom Practice
An exploration of the major issues and research results that apply to the teaching and learning of secondary science and mathematics.
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Class(es): Graduate
Pre-Requisite(s): ED 5700
ED 5750 - Diagnosis and Remediation of Reading Problems
Identification of problems related to reading and language processing; identification and application of diagnostic, remediation and assessment strategies and instruments. Classroom specific experience in diagnosis and remediation of the total communication process.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: On Demand
Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): ED 5700
ED 5810 - Advance Methods of Teaching Science, Math, and Computer Science
Application of learning and instructional theories to the teaching of science, mathematics, and computer science. Emphasizes methods of materials used to teach early adolescents. Taught from the perspective of science/math/computer science teachers. Lab offers opportunities to refine instructional techniques. Admission to teacher education required.
Credits: 4.0
Lec-Rec-Lab: (0-3-3)
Semesters Offered: On Demand
Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): ED 5910
Co-Requisite(s): ED 5110 and ED 5210 and ED 5310 and ED 5410
ED 5850 - Science Teacher Leaders Intern
Teachers will work with National Park interpreters about engaging diverse learners in scientific inquiry based on the natural environment and to prepare technology-rich informal modules.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Summer
Restrictions: Permission of department required
ED 5900 - Graduate Research in Education
Students will conduct a research project/report as a capstone to an approved plan of study. The student should present a project plan to their education advisor for approval, conduct whatever work is necessary for the project, prepare a final report at the conclusion of the project, and defend the project/report in an oral presentation.
Credits: variable to 6.0; Repeatable to a Max of 6
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): ED 5700
ED 5910 - Teaching Internship
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. Completion of MTTC Basic Skills Test. See department for application deadlines.
Credits: 12.0
Lec-Rec-Lab: (0-0-36)
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Co-Requisite(s): ED 5810
Pre-Requisite(s): ED 5110 and ED 5210 and ED 5410
ED 5920 - Teaching Internship - Preparation for International Teaching
Application of learning theory, including individual differences and content specific pedagogy, in a classroom setting, conducted under supervision of an experienced secondary teacher. Preparation for placement in teaching position with the Peace Corps. Requires completion of MTTC Basic Skills Test.
Credits: variable to 6.0
Semesters Offered: On Demand
Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): ED 4710(C) or ED 5810(C)
ED 5921 - International Teaching Internship
Application of learning theory, including individual differences and content specific pedagogy, in an international classroom through Peace Corps service. Internship is conducted under the supervision of an experienced secondary teacher. Requires completion of MTTC Basic Skills Test.
Credits: variable to 6.0; Repeatable to a Max of 12
Semesters Offered: On Demand
Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): ED 4710 or ED 5810
ED 5975 - Full Time Master’s Research
Open to students who have successfully completed all the required courses as well as the required number of credits for the master’s degree. Students in this course are involved in full-time research. Tuition for this course is charged at the graduate full-time research rate. Students enrolled in this course may not register for any other course.
Credits: 9.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-9-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate
ED 5994 - Field Work in International Science Education
Field work and reporting from students in the Peace Corps Master's International Program in Science Education.
Credits: 1.0; Repeatable to a Max of 10
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate
ED 5995 - Field Work in International Science Education
Field work and reporting from students in the Peace Corps Master's International Program in Science Education.
Credits: 1.0; Repeatable to a Max of 3
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate
ED 5996 - Field Work in International Science Education
Field work and reporting from students in the Peace Corps Master's International Program in Science Education.
Credits: 1.0; Repeatable to a Max of 6
Lec-Rec-Lab: (0-6-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate
Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

Electrical Engineering
EE 1000 - Explorations in Computing
Introduction to the full spectrum of computing disciplines offered at Michigan Tech. Topics include an introduction to technical aspects of the various disciplines, degree choices, career opportunities, ethical issues, and the impact of computers on modern society.
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Major(s): Electrical Engineering, Software Engineering, Computer Science, Computer Systems Science, Computer Engineering, Engineering Undeclared
EE 2110 - Electric Circuits
Introduction to linear circuit analysis, circuit elements, network theorems, steady-state sinusoidal response, transient response using Laplace transforms, and frequency response.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): EE 2150 and (MA 3520 or MA 3521 or MA 3530 or MA 3560)
EE 2150 - Introduction to Signal Processing
Introduces the mathematical modeling techniques used in the design and analysis of analog and digital signal-processing systems. Topics include analog and digital signal processing, spectral representations, filtering, frequency response, and the Fourier and Z-transforms. Applications include communication, control, audio, video, and image processing systems. 
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): MA 2160 and (CS 1121 or CS 1131)

EE 2173 - Digital Logic
Introduces analysis, design and application of digital logic. Includes Boolean algebra, binary numbers, logic gates, combinational and sequential logic, storage elements, schematic and hardware-description-language based synthesis. 
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Pre-Requisite(s): MA 3521 and PH 2200(C)

EE 2190 - Introduction to Photonics
Topics include basic geometrical and wave optics, fiber optics, lasers, detectors, and optical communication systems. 
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Pre-Requisite(s): MA 3521 and PH 2200(C)

EE 2203 - Introduction to ECE Lab
First laboratory course in Electrical Engineering. Introduces basic concepts of laboratory practice, measurements, instruments, modeling and simulation tools. 
Credits: 1.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): EE 2150 and (EE 2171 or EE 2173) and EE 2303

EE 2304 - Logic and Signals Lab
Experimental solution of engineering problems. Includes design, simulation, and evaluation, advanced measurement techniques in digital and signal processing systems. 
Credits: 1.0
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): EE 2190 and (EE 2171 or EE 2173) and EE 2303

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: Spring
Pre-Requisite(s): EE 3160

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 2304

EE 3130 - Electronics
Covers the fundamentals of electronic circuits and devices. 
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): EE 2110 or EE 2304

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): EE 2110 or EE 2304

EE 3160 - Linear Systems and Control
Introduces the mathematical analysis of signals, systems, and control. Topics include differential equations, Fourier 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 2190 and (MA 2320 or MA 2321 or MA 2330) and (MA 3520 or MA 3521 or MA 3530 or MA 3560)

EE 3170 - Microcontroller Applications
Introduces the concept of microcontroller-based systems. Describes some basic characteristics of microcontrollers and then goes into significant depth in the applications of a single microcontroller. Topics include polled, interrupt and DMA input/output, assembly language, instruction set architecture interface and ASICS. 
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): EE 2171 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 microcontroller - or microcontroller-based systems, communication and bus protocols, programming in assembler language and in "C", system integration and testing. Also covers the use and integration of PPGs using both schematic capture and HDL design tools. 
Credits: 4.0
Lec-Rec-Lab: (0-3-3)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): EE 2304 and EE 3130 and CS 2141 and CS 3421

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 2190

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: Fall, Spring, Summer
Pre-Requisite(s): EE 3160

EE 3221 - Introduction to Motor Drives
Provides a thorough understanding of how electric motor drives can be used to control speed and position in various applications. Course is equally useful for nonmajors. 
Credits: 4.0
Lec-Rec-Lab: (0-3-2)
Semesters Offered: Spring
Pre-Requisite(s): EE 2110 or EE 3010

EE 3291 - Photonic Material and Devices
Light wave propagation in optical crystals and fibers, detection and creation of light in semiconductors. 
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Pre-Requisite(s): EE 2190 or EE 3140 or PH 2400

EE 3305 - Circuit and Analysis Lab
Covers circuit design and analysis, and linear system applications 
Credits: 1.0
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): EE 2190 or EE 3140 or PH 2400

EE 3306 - Electronic Design with Microprocessor Applications
Covers the design and analysis of electronic circuits with microprocessor applications 
Credits: 1.0
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): EE 3305 and EE 3130 and EE 3170
EE 3391 - Photonics Laboratory
Basic optics lab experience covering geometrical optics, fiber optics, interferometry and diffraction. Optical measurements and laser safety are also covered.
Credits: 1.0
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Major(s): Electrical Engineering; May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): EE 2190 and EE 3190

EE 3805 - 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 4000 - Undergraduate Research
An undergraduate research experience during the senior year in electrical or computer engineering. Students work on an active research project/grant with a faculty member. A report will be published in the department and archived.
Credits: variable to 4.0; Repeatable to a Max of 6
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior

EE 4221 - Power System Analysis 1
Complex Power flow in circuits and the effects of real and reactive power flow on a system; transformer and load representations in power systems; power transmission line parameters and steady-state operation of transmission lines; the per unit system; development of the bus admittance matrix; power flow.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): EE 4221

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: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): EE 4221

EE 4223 - Power System Protection
Real-time monitoring and protection of modern power systems. Secure and reliable operation of radial and grid systems. Protection of transmission lines, buses, generators, motors, transformers, and other equipment against disturbances.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2008-2009 academic year
Pre-Requisite(s): EE 4221 and EE 4222(C)

EE 4224 - Power System Protection Lab
Theory-based application of software and hardware used for power system protection. Fault simulations, protective relay settings and coordination, and test operation of relays under static, dynamic, and transient conditions.
Credits: 1.0
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Spring - Offered alternate years beginning with the 2008-2009 academic year
Pre-Requisite(s): EE 4223(C)

EE 4225 - Distribution Engineering
Modeling and analysis of electrical distribution systems; load characteristics, load modeling, unbalanced three-phase overhead and underground line models, and distribution transformers. Analysis of over current protection, voltage drop, and power quality
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2005-2006 academic year
Restrictions: Must be enrolled in one of the following Major(s): Electrical Engineering, Computer Engineering
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, load flow and fault simulations, relay settings and relay testing and calibration.
Credits: 1.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Summer
Restrictions: Permission of instructor required
Pre-Requisite(s): EE 4221 and EE 4222(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: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): EE 4231

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, Schmitt triggers, non-linear models of semiconductor devices, the factors that limit switching speed, the switching of reactive elements, and DC-DC converters.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): EE 4232

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

EE 4250 - Communication Theory
Introduces the mathematical theory of communication science. Topics include baseband and digital signaling, bandpass signaling, AM and FM systems, bandpass digital systems, and case studies of communication systems.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): EE 4221 and EE 4222(C)

EE 4252 - Digital Signal Processing and its Applications
Digital signal processing techniques with emphasis on applications. Includes sampling, the Z-transform, digital filters and discrete Fourier transforms. Emphasizes techniques for design and analysis of digital filters. Special topics may include the FFT, windowing techniques, quantization effects, physical limitations, image processing basics, image enhancement, image restoration and image coding.
Credits: 4.0
Lec-Rec-Lab: (0-3-2)
Semesters Offered: Fall
Pre-Requisite(s): EE 4252

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: (0-2-2)
Semesters Offered: Spring
Pre-Requisite(s): EE 4252

EE 4255 - Wireless Communications
Principles of wireless communication systems. Projects may include cell phones, computer networks, paging systems, satellite communications, radio, television and telemetry.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): EE 4250

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 2190 or EE 3140
EE 4257 - Digital Image Processing
Image formation, enhancement and reconstruction. Applications in medical imaging, computer vision, and pattern recognition.
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. Must be enrolled in one of the following Class(es): Senior

EE 4258 - Wireless Communication Lab
Students work with many advanced instruments and software to design and test communication systems. Students receive a better view on many materials covered in EE4250 and EE4255.
Credits: 1.0
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Spring
Co-Requisite(s): EE 4255
Pre-Requisite(s): EE 4250

EE 4261 - Classical 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.); design using frequency response, root locus, state-variable methods; analog and digital simulation and computation; and experiments with physical systems.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Fall
Pre-Requisite(s): EE 3160

EE 4262 - Digital and Non-linear Control
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); introduction to hierarchical systems; and experiments with physical systems.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Spring
Pre-Requisite(s): EE 4261

EE 4271 - VLSI Design
Design of VLSI circuits using CAD tools. Analysis of physical factors affecting performance.
Credits: 4.0
Lec-Rec-Lab: (0-3-2)
Semesters Offered: Fall, Summer
Pre-Requisite(s): EE 3130 and (EE 2171 or EE 2173)

EE 4272 - Computer Networks
Focuses on the fundamental network architecture concepts and the core design principles and issues in the emerging communication/data networks. The course systematically gives students the complete picture of data and computer networks.
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): EE 2150 and (MA 3710 or MA 3720 or EE 3180)

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 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 4431 - Computer Architecture
Architecture of high-performance parallel computer systems. Introduces various forms of parallelism, such as multiple functional units, pipelining, multiprocessors, and processor arrays. Also covers interleaved memory, caching, and interconnection networks. Includes analytic and simulation models of architectural features that implement or support parallel processing.
Credits: 4.0
Lec-Rec-Lab: (3-0-3)
Semesters Offered: Fall, Spring
Pre-Requisite(s): CS 3421

EE 4441 - Laser Types, Laser Design, Modeling Techniques, and Nonlinear Optics
Survey of laser types and analysis of the common physical and engineering principles, including energy states, inversion, gain, and broadening mechanisms. Design issues include resonators, packaging, cooling, pulsed power, and safety. Students will construct a computational model that predicts laser performance. Nonlinear optics and selected applications also covered.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Pre-Requisite(s): EE 3140

EE 4723 - Computer and 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: Spring
Pre-Requisite(s): EE 4272

EE 4732 - Real-Time System Design
Introduces the fundamentals of Real-Time system design from practicing engineer's point of view. Focus will be on hardware, operating system, and software issues with topics derived from scheduling theory, algorithms, computer architecture and organization, hardware design, and operating systems.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Pre-Requisite(s): EE 20173 or EE 4431 or CS 4431

EE 4735 - Embedded System Programming using Sensor Networks and Mobile Robots
Introduces concepts and skills of microcontrollers with limited resources. Describes basic microcontroller interfaces with sensors, motors and networks. Topics include microcontroller programming using C, real time operating systems, embedded networking and embedded control, sensor networks, and mobile robotics.
Credits: 3.0
Lec-Rec-Lab: (2-0-2)
Semesters Offered: Spring
Pre-Requisite(s): CS 3421

EE 4751 - Verilog HDL Design
Use of Verilog Hardware Description Language (HDL) to model, simulate, and synthesize combinational and sequential digital hardware systems. Emphasis is on developing Verilog models of encryption and authentication cryptographic algorithms.
Credits: 3.0
Lec-Rec-Lab: (2-0-2)
Semesters Offered: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): EE 2171 or EE 2173

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 4900 - 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: Fall
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): UN 2001 and UN 2002
EE 4901 - 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: 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-Prerequisite(s): EE 4900
Pre-requisite(s): (EE 3305 or EE 3173) and (EE 3130 or EE 4431) and EE 4900(C)
EE 4910 - 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: 3.0
Lec-Rec-Lab: (0-1-6)
Semesters Offered: Spring
Pre-requisite(s): EE 4901

EE 5200 - Advanced Methods in Power Systems
Advanced analysis and simulation methods for load flow, symmetrical components, short circuit studies, optimal system operation, stability, and transient analysis. Application of commonly used software concepts and provides practical insights.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Electrical Engineering, Electrical Engineering; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior
Pre-requisite(s): EE 4222

EE 5220 - Transient Analysis Methods
A study of transient behaviors and their analysis and prediction. Addresses analytical methods and their numerical implementation, switching and lightning surges, short circuits, and non-linear effects. Includes computer simulations.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2007-2008 academic year
Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Electrical Engineering, Electrical Engineering; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior
Pre-requisite(s): EE 4222

EE 5230 - Power System Operations
Study of advanced engineering and economic algorithms and analysis techniques for the planning, operation, and control of the electric power system from generation through transmission to distribution.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Electrical Engineering, Electrical Engineering
EE 5240 - Computer Modeling of Power Systems
Topics include modeling and computer methods applied to electrical power systems, matrix formulations, network topology and sparse matrix data structures, loadflow, short-circuit and stability formulations, constrained optimization methods for loadflow and state estimation, and time-domain simulation methods for transient analysis.
Credits: 3.0
Lec-Rec-Lab: (3-0-3)
Semesters Offered: Spring - Offered alternate years beginning with the 2008-2009 academic year
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-requisite(s): EE 5200

EE 5250 - Distribution Engineering
Modeling and analysis of electrical distribution systems; load characteristics, load modeling, unbalanced three-phase overhead and underground line models, and distribution transformers. Analysis of over current protection, voltage drop, and power quality.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2007-2008 academic year
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-requisite(s): EE 4221

EE 5260 - Wind Power
Wind turbines are the fastest growing segment of the generator mix being added to power systems today. There is a growing need to understand the many issues caused by these additions. This course covers the theoretical background, regulations, integration experience, and modeling.
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, Junior

EE 5290 - Selected Topics in Power Systems 1
Selected topics of current interest.
Credits: variable to 4.0; May be repeated
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Electrical Engineering, Electrical Engineering

EE 5410 - 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
Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Electrical Engineering, Electrical Engineering
Pre-requisite(s): EE 3140

EE 5430 - Electronic Materials
A study of the physical principles, operational characteristics, models, and basic applications of selected solid-state devices.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate

EE 5440 - Laser Types, Laser Design, Modeling Techniques, and Nonlinear Optics
Survey of laser types and analysis of the common physical and engineering principles, including energy states, inversion, gain, and broadening mechanisms. Design issues include resonators, packaging, cooling, pulsed power, and safety. Students will construct computational model that predicts laser performance. Nonlinear optics and selected applications also covered.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate

EE 5470 - Solid State Devices
A study of the physical principles, operational characteristics and models and basic applications of solid state devices such as p-n junctions, metal-semiconductor junctions and transistors.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall

EE 5480 - Advanced MEMS
This course will cover advanced topics dealing with MEMS technologies, transduction mechanisms, and microfabricated sensors and actuators and is a continuation of EE 4240/EE 4420.
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, Junior
Pre-requisite(s): EE 4240 or MY 4240
EE 5500 - Statistical Signal Processing
Focuses on the application of statistical techniques to the study of random signals and noise. Includes random processes in continuous and discrete time and space, second-order properties of random processes, the interaction of random processes with linear systems, parameter estimation, and the design and implementation of statistical signal-processing algorithms.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Electrical Engineering, Electrical Engineering

EE 5511 - Information Theory
Mathematical models for channels and sources; entropy, information, data compression, channel capacity, Shannon's theorems, and rate-distortion theory.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2007-2008 academic year
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): EE 5500

EE 5512 - Coding Theory
General discussion on coding theory with emphasis on the algebraic theory of cyclic codes using finite field arithmetic, decoding of BCH and RS codes, convolutional codes and trellis decoding algorithms.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2008-2009 academic year
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): EE 5511

EE 5520 - Fourier Optics
Analysis and modeling of diffraction effects on 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 Level(s): Graduate; Must be enrolled in one of the following Major(s): Electrical Engineering, Electrical Engineering
Pre-Requisite(s): EE 3190

EE 5521 - Detection & Estimation Theory
Detecting and estimating signals in the presence of noise. Optimal receiver design. Applications in communications, signal processing, and radar.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Electrical Engineering, Computer Engineering
Pre-Requisite(s): EE 5500

EE 5522 - Digital Image Processing
Image formation, enhancement, and reconstruction. Applications in medical imaging, computer vision, and pattern recognition.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Electrical Engineering, Computer Engineering
Pre-Requisite(s): EE 3190 and EE 3160

EE 5525 - Wireless Communications
Principles of wireless communications systems. Projects may include cell phones, computer networks, paging systems, satellite communications, radio, television and telemetry.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Electrical Engineering, Computer Engineering
Pre-Requisite(s): EE 3190 and EE 3160

EE 5527 - Digital Communications
This course focuses on the basic principles that underlie the analysis and design of digital communication systems. Topics covered include: characterization of communication signals and systems, modulation schemes, optimum receiver design and performance analysis in AWGN and band-limited channels, concepts of information theory and channel coding, carrier and symbol synchronization, and ISI channel equalization.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): EE 4250

EE 5535 - Wireless Communications II - Advanced Topics
The objective of this course is to identify and understand some of the key research issues and recent research advances in wireless communications. This course will provide a brief introduction to wireless communication systems, visions and challenges, wireless channel modeling, channel estimation, diversity and fading. MIMO multi-antenna systems and space-time coding, as well as selected topics of contemporary interest, such as turbo coding, multi-carrier OFDM, and ultra-wideband systems.
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): EE 4250 and EE 5527

EE 5540 - Statistical Optics
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Electrical Engineering, Electrical Engineering

EE 5722 - Computer Networks
Focuses on the fundamental network architecture concepts and the core design principles and issues in the emerging communication/data networks. The course systematically gives students the complete picture of data and computer networks.
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): (MA 3710 or MA 3720 or EE 3180) and EE 2150

EE 5723 - Computer and 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: Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): EE 2150 and (MA 3710 or MA 3720 or EE 3180)

EE 5725 - Mobile Robotics & Multi-Robot Systems
Introduction to mobile robotics and multi-robot systems. Introduce spatial description, mobile robot locomotion, kinematics, localization and mapping, multi-path planning and navigation. Topics in multirobot systems include biological inspirations, control structure, inter-robot communication, learning in multi-robot systems, and modeling and analysis.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: On Demand
Pre-Requisite(s): (EE 3160 or EE 4261) and (MA 3710 or MA 3720 or EE 3180) and (CS 1129 or CS 2141)

EE 5726 - Embedded Sensor Networks
Introduces the concepts of wireless sensor networks. Topics include sensor network coverage and sensor deployment, time synchronization and sensor node localization, network protocols, data storage and very, collaborative signal processing. Introduce sensor network programming network reliability and tolerance.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: On Demand
Pre-Requisite(s): (CS 4461 or EE 4272 or EE 5722) and (EE 3170 or EE 3173) and (CS 1129 or CS 2141)

EE 5732 - Real-Time System Design
Introduces the fundamentals of Real-Time system design from practicing engineer's point of view. Focus will be on hardware, operating system, and software issues with topics derived from scheduling theory, algorithms, computer architecture and organization, hardware design, and operating systems.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): EE 3173 or CS 4431 or EE 4431
EE 5751 - Verilog HDL Design
Use of Verilog Hardware Description Language (HDL) to model, simulate, and synthesize combinational and sequential digital hardware systems. Emphasis is on developing Verilog models of encryption and authentication cryptographic algorithms.
Credits: 3.0
Lec-Rec-Lab: (2-0-2)
Semesters Offered: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): EE 2171 or EE 2173

EE 5752 - Digital Storage Technologies
Digital Storage Technologies including solid state memory devices, magnetic and optical disks will be covered. The usage of the available technologies in a microprocessor system memory hierarchy will be explored using architectural simulation tools.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2008-2009 academic year
Restrictions: Must be enrolled in one of the following Level(s): Graduate; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior
Pre-Requisite(s): EE 3173

EE 5755 - Fault-Tolerant Systems
Covers both the theory and the practice of how to design, model, evaluate, and implement reliable systems out of unreliable components. Includes: Fault Models, Redundancy Management, Agreement, Consensus, Voting, Clock synchronization and reliable broadcast. Material is reinforced with real-world case studies.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: On Demand
Pre-Requisite(s): (MA 3710 or MA 3720) and CS 4411 and (EE 3175 or EE 4431 or CS 4431)

EE 5805 - Directed Study in Electrical & Computer Engineering
Directed study on a topic mutually agreed upon by the student and the instructor.
Credits: variable to 3.0; Repeatable to a Max of 6
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Electrical Engineering, Electrical Engineering

EE 5900 - Special Topics in Electrical Engineering
Special topics in electrical engineering selected by the student and approved by his/her advisor and the faculty member who will approve the study.
Credits: variable to 5.0; May be repeated
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Electrical Engineering, Electrical Engineering

EE 5920 - Power Systems Seminar
An analytical study of any current high-level problem or series of problems associated with the advance of knowledge in power systems.
Credits: 1.0; May be repeated
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Electrical Engineering, Electrical Engineering

EE 5940 - Electrophysics Seminar
An analytical study of any current high-level problem or series of problems associated with the advance of knowledge in electrophysics.
Credits: 1.0; May be repeated
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Electrical Engineering, Electrical Engineering

EE 5950 - Signals and Systems Seminar
An analytical study of any current high-level problem or series of problems associated with the advance of knowledge in signals and systems.
Credits: 1.0; May be repeated
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Electrical Engineering, Electrical Engineering

EE 5970 - Computer Engineering Seminar
An analytical study of any current high-level problem or series of problems associated with the advance of knowledge into computer engineering.
Credits: 1.0; Repeatable to a Max of 2
Lec-Rec-Lab: (1-0-0)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Electrical Engineering, Computer Engineering

EE 5975 - Full Time Master's Research
Open to students who have successfully completed all the required courses as well as the required number of credits for the master's degree. Students in this course are involved in full-time research. Tuition for this course is charged at the graduate full-time research rate. Students enrolled in this course may not register for any other course.
Credits: 9.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-9-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

EE 5990 - Thesis Research in Electrical Engineering
Study of some acceptable electrical engineering problem and preparation of a thesis.
Credits: variable to 10.0; May be repeated; Graded Pass/Fail Only
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required

EE 5991 - Project Research in Electrical Engineering
Study of some acceptable electrical engineering problem and preparation of a report.
Credits: variable to 6.0; May be repeated; Graded Pass/Fail Only
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required

EE 5992 - Practical Experience in Electrical Engineering
A collaboration with industry on some acceptable electrical engineering task and preparation of a report.
Credits: variable to 4.0; May be repeated; Graded Pass/Fail Only
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required

EE 6210 - Power System Dynamics and Stability
A study of the dynamic behavior of power systems. A review of synchronous machine modeling, system dynamic equations, and method of analysis. Examines overall system behavior via small signal and transient stability and energy functions. Also studies voltage stability and non-linear effects.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): EE 5200

EE 6975 - Full-Time Doctoral Research
Open to students who have successfully completed all required courses as well as the comprehensive and proposal defense exams. Students in this course are involved in full-time research. Tuition for this course is charged at the graduate full-time research rate. Students enrolled in this course may not register for any other course.
Credits: 9.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-9-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

EE 6990 - Doctoral Research
Original research leading to the preparation of a dissertation in partial fulfillment of the requirements for the PhD degree.
Credits: variable to 15.0; May be repeated; Graded Pass/Fail Only
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required

Electrical Engrg 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
Pre-Requisite(s): MA 1031(C) or MA 1032(C) or MA 1160(C) or MA 1161(C) or MA 1135(C)
EET 1411 - Basic Electronics
Introduction to basic electrical principles and communication systems, including dc and ac circuits, diodes, transistors, operational amplifier ICs, power supply regulation, elements of communication systems, theory of wave and light propagation.
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 Admn
Pre-Requisite(s): MA 1135(C) or MA 1160(C) or MA 1161(C) or MA 1161(C) or MA 1161(C) or MA 1135(C)
EET 2010 - Computational and Statistical Applications
Solve complex computational problems by using appropriate software (MathCad or MATLAB) to generate solutions. Includes time series and frequency analysis (Fourier, Laplace, Z transforms), statistical analysis of experimental data, and topics such as experimental design, factor analysis, and quality control.
Credits: 3.0
Lec-Rec-Lab: (0-2-3)
Semesters Offered: Fall, Spring
Pre-Requisite(s): MA 2180(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, Spring, Summer
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: Fall, Spring
Pre-Requisite(s): EET 2120(C)
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
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. Focus on the basic capabilities of MATLAB and its programming environment.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Fall
Pre-Requisite(s): MA 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, digital memory.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Spring, Summer
Restrictions: Must be enrolled in one of the following Major(s): Computer Network & System Admn
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 digital data communications methods.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Spring
Pre-Requisite(s): EET 1411 or EET 2220
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 3142 - Operating System Concepts
Operating system concepts: memory management, process management, and file management; sample operating systems.
Credits: 3.0
Lec-Rec-Lab: (0-2-3)
Semesters Offered: Spring
Pre-Requisite(s): EET 3141 and EET 2142
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: Spring
Pre-Requisite(s): EET 2142 and EET 3141
EET 3225 - Special Electronic Devices
An advanced course in the study of linear integrated circuits. Includes op amps, comparators, waveform 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: Spring
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: Fall, Spring
Pre-Requisite(s): EET 2220
EET 3353 - Data Acquisition with LabView
An introduction to graphical programming in G. National Instruments LabVIEW software is used in learning the fundamentals of graphical programming. Data acquisition and control programs are written, and transducer utilization and signal conditioning studied.
Credits: 3.0
Lec-Rec-Lab: (0-2-3)
Semesters Offered: Spring
Pre-Requisite(s): EET 1411 or EET 2220 or EE 3010
EET 3367 - Communications Systems  
A basic course in communications systems. Includes information theory, AM receiving and transmission, SSB, frequency and phase angle modulation systems, TV, and frequency synthesis. Also includes system modeling using block diagrams and analysis of typical circuits.  
Credits: 4.0  
Lec-Rec-Lab: (0-3-3)  
Semesters Offered: Fall  
Pre-Requisite(s): EET 3225

Semesters Offered: Fall  
Pre-Requisite(s): EET 1411 or (EET 2120 and EET 2141) or EET 2411

EET 3373 - Introduction to Programmable Controllers  
The design of discreet sequential control 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 design. Data acquisition is introduced using BridgeVIEW software.  
Credits: 3.0  
Lec-Rec-Lab: (0-2-3)  
Semesters Offered: Fall  
Pre-Requisite(s): EET 2233

EET 3390 - Power Systems  
Study of transmission of electric power from generators to loads, system components, and system performance. Covers basic power systems and their analysis, the per-unit system, faults on power systems, circuit interrupting devices, system instrumentation, automatic protection systems, and safety and grounding.  
Credits: 3.0  
Lec-Rec-Lab: (0-3-0)  
Semesters Offered: Fall  
Pre-Requisite(s): EET 2233

EET 3411 - 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 4141 - Microcomputer Interfacing  
A continuation of EET3267. Topics include transmission lines, wave propagation, antennas, fiber optics, digital communications, and applications of those ideas to mobile wireless communications systems.  
Credits: 4.0  
Lec-Rec-Lab: (0-2-3)  
Semesters Offered: Spring  
Pre-Requisite(s): EET 3367 and MA 2160

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 3353

EET 4333 - Advanced Data Acquisition with LabView  
This course focuses on developing techniques in data acquisition, controls, and signal processing. Projects include designing and building circuit interfaces with real world applications and hardware, writing LabView programs for data acquisition, control, and performing noise filtering and signal smoothing.  
Credits: 3.0  
Lec-Rec-Lab: (0-2-3)  
Semesters Offered: On Demand  
Pre-Requisite(s): EET 3353 or EET 3131

EET 4367 - Wireless Communications  
A continuation of EET3267. Topics include transmission lines, wave propagation, antennas, fiber optics, digital communications, and applications of those ideas to mobile wireless communications systems.  
Credits: 4.0  
Lec-Rec-Lab: (0-2-3)  
Semesters Offered: Spring  
Pre-Requisite(s): EET 3367

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: (1-0-2)  
Semesters Offered: Fall, Spring, Summer  
Restrictions: May 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: (1-0-2)  
Semesters Offered: Fall, Spring, Summer  
Restrictions: Must be enrolled in one of the following Class(es): Senior

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

EET 4997 - Independent Study in Electrical Engineering Technology  
Independent study of an approved topic under the guidance of an Electrical 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): Electrical Eng Tech (BS); Must be enrolled in one of the following Class(es): Senior

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Exercise Science & Health

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

EH 1100 - Foundations of Health and Physical Education
Introduction to the fields, career opportunities, and curriculum in health and physical education. Covers historical and social precedents, current problems and controversies. Includes observation.
Credits: 2.0
Lec-Rec-Lab: (2-0-0)
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 2010 - Principles of Weight Training and Aerobics
Students learn the complimentary roles of aerobics and weight training in a complete fitness program. Emphasis will be placed on implementing a personal fitness approach, encouraging participation for all levels, ages, and experiences, and in a variety of settings.
Credits: 2.0
Lec-Rec-Lab: (1-0-1)
Semesters Offered: Spring

EH 2020 - Introduction to Individual Sports
Students learn to present a variety of individual sports. Emphasis will be placed on various teaching methods and strategies for the sequencing skills, the presentation of skills, skill drills, rules, methods of evaluation, and game situations for teaching in a variety of settings.
Credits: 2.0
Lec-Rec-Lab: (1-0-1)
Semesters Offered: Spring

EH 2029 - Outdoor Emergency Care Training (Ski Patrol)
Second of two-course sequence required for Alpine and Nordic Ski Patrol candidates. Ninety hours of instruction includes three weekends. Requires payment of dues to become member of National Ski Patrol. Certification in National Ski Patrol Outdoor Emergency Care is available upon completion.
Credits: 2.0
Lec-Rec-Lab: (0-0-6)
Semesters Offered: Fall
Pre-Requisite(s): PE 2028

EH 2030 - Introduction to Team Sports
Students learn to present a variety of team sports. Emphasis will be placed on various teaching methods and strategies for the sequencing skills, the presentation of skills, skill drills, rules, methods of evaluation, and game situations for teaching in a variety of settings.
Credits: 2.0
Lec-Rec-Lab: (1-0-1)
Semesters Offered: Fall

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, Spring

EH 2200 - Human Reproductive Health & Development
Examines the biological and behavioral dynamics of human sexuality and sexuality education with the identification and examination of contemporary issues. Emphasis will be placed on sexuality education in schools and the community.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall

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.
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).
Credits: 1.0
Lec-Rec-Lab: (1-0-0)
Semesters Offered: Spring
Co-Requisite(s): PE 1580

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: 3.0
Lec-Rec-Lab: (2-0-1)
Semesters Offered: Fall, Spring, Summer
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 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, Summer

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 arthritis, osteoporosis, dyslipidemia, 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 3150 - Health of Special Populations
Designed to help students identify and develop effective health education programming that will lead to the reduction of health disparities which exist in special populations. Includes youth, elderly, pregnant, pulmonary disease, vascular disease and musculoskeletal disorders.
Credits: 2.0
Lec-Rec-Lab: (2-0-0)
Semesters Offered: Spring

EH 3300 - Principles of Neuroscience
Comprehensive introductory course focusing on the field of neuroscience. The course will cover the anatomy and physiology of neurons, the process of synaptic communication, and structure of complex neural systems that control motor, sensory, and other basic physiological functions.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Pre-Requisite(s): BL 2020 and BL 2021

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EH 3400 - Modification of Health Behavior
This course will provide students with the knowledge, skills, and abilities to comprehend and apply theories and strategies to help individuals and groups modify and maintain targeted health behaviors. Class requirements will include an individual Health Improvement Project.
Credits: 2.0
Lec-Rec-Lab: (2-0-0)
Semesters Offered: Fall

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. Students will be prepared to take a personal trainer's exam if they so choose.
Credits: 3.0
Lec-Rec-Lab: (2-0-2)
Semesters Offered: Fall - Offered alternate years beginning with the 2010-2011 academic year

EH 3800 - 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 any strength and conditioning facility.
Credits: 2.0
Lec-Rec-Lab: (1-0-1)
Semesters Offered: Fall

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: (0-0-2)
Semesters Offered: Fall

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: Fall, Spring

EH 4070 - Curriculum and Methods of Coaching
Students will demonstrate knowledge of skills, tactics and strategies, and sporting principles in planning learning experiences in various physical activities for children K-12, with consideration of appropriate growth, development, and learning.
Credits: 3.0
Lec-Rec-Lab: (2-0-1)
Semesters Offered: Spring - Offered alternate years beginning with the 2007-2008 academic year

EH 4080 - Sports & Facility Management
Organizing and administering the total school health program for secondary schools. Includes health instruction, school health services, and the school health environment with emphasis on legal considerations, public relations, personnel, program facilities, and financial management.
Credits: 2.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Spring

EH 4090 - Theory of Training
Fundamentals of training, endurance, and sprint athletics. Topics include goal setting, intensities, lactate threshold, oxygen uptake, recovery, periodization, injuries, and nutrition.
Credits: 2.0
Lec-Rec-Lab: (2-0-0)
Semesters Offered: Spring

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

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

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

EH 4300 - Program Administration of Health Education
Organizing and administering the total school health program for secondary schools. Includes health instruction, school health services, and the school health environment with emphasis on legal considerations, public relations, personnel, program facilities, and financial management.
Credits: 2.0
Lec-Rec-Lab: (0-2-0)
Semesters Offered: Spring

EH 4301 - Program Administration for Physical Education
Organizing and administering a physical education or sport program with emphasis on legal considerations, public relations, personnel, program facilities, equipment and financial management.
Credits: 2.0
Lec-Rec-Lab: (2-0-2)
Semesters Offered: Spring

EH 4400 - Motor Control
Designed for upper level undergraduates or graduates with a basic neuroscience background. Students learn the basics of how the neural and muscular systems coordinate human movement. This will require an integration of biomechanics, molecular and cellular neurophysiology, cognitive neuroscience, and sensory motor skills.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall

EH 4420 - 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

EH 4420(C)
Restrictions: Must be enrolled in one of the following Major(s): Health and Physical Education; May not be enrolled in one of the following Class(es): Freshman, Sophomore

EH 4430 - Program Administration for Physical Education
Organizing and administering a physical education or sport program with emphasis on legal considerations, public relations, personnel, program facilities, equipment and financial management.
Credits: 2.0
Lec-Rec-Lab: (2-0-2)
Semesters Offered: Spring

NH 4000(C)
Restrictions: Must be enrolled in one of the following Major(s): Health and Physical Education; May not be enrolled in one of the following Class(es): Freshman, Sophomore

EH 4440 - Motor Learning and Development
Designed for upper level undergraduates or graduates with a basic neuroscience background. Students learn the basics of how humans learn to control muscles and coordinate movement (motor learning), and how motor behavior progressively changes throughout a life cycle (motor development).
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall

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: (2-0-1)
Semesters Offered: Fall

EH 4500(C)
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

EH 4500(C)
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

EH 4500(C)
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

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EH 4970 - Curriculum and Methods of Teaching Health and Education
A course in program planning and techniques of teaching physical education and health education in the secondary schools. Includes critical analysis of methods now in use in physical education and health education, their inter-relationship and criteria for evaluation or programs. Unit planning, daily lesson plans, teaching aids, materials for the program included.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Major(s): Health and Physical Education; Must be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): BL 3970 and EH 4420 and EH 4301 and EH 4300 and ED 4150

EH 4800 - Internship in Health and Physical Education
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 40 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): Health and Physical Education; May not be enrolled in one of the following Class(es): Freshman, Sophomore

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 40 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 4790 - Curriculum and Methods of Teaching Health and Education
An introduction to the engineering profession. Focuses on engineering analysis, computational skills, and communication skills.
Credits: 2.0
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: (0-0-2)
Semesters Offered: Spring
Pre-Requisite(s): ENG 1001 and (MA 1160(C) or MA 1161(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)) and (Spatial Visualization Score >= 18 or ENG 1002(C))

ENG 1102 - Engineering Modeling and Design
Continuation of ENG1101. 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): ENG 1101 or ENG 1001 and ENG 1100) and (MA 1160 or MA 1161)

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

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 behavioral behavior of materials, including calculation of stresses, strains, and deformations due to axial, torsional, and flexural loading.
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

ENG 3000 - Engineering for Non-Believers
Everything you wanted to know about engineering but were afraid to ask. This course will take students on a journey through time investigating engineering's greatest feats and greatest lies. Students will work in teams to uncover basic engineering principles and how basic math skills help engineers do the things they do.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following College(s): College of Engineering
Pre-Requisite(s): UN 2002(C)

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.
Credits: 4.0
Lec-Rec-Lab: (0-4-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): MA 2160 and CH 1100 or CH 1110 or CH 1112 or (CH 1150 and CH 1151) and PH 2100 and ENG 1102
ENG 3507 - Introduction to Fluid Mechanics
Provides engineering students with a unified understanding of fluid dynamic systems. Topics will include but are not limited to hydrostatics, Bernoulli, pipe flow and loss, and lift and drag. Course offered second half of spring semester.
Credits: 2.0
Lec-Rec-Lab: (0-2-0)
Semesters Offered: Winter, Summer
Pre-Requisite(s): PH 2100 and CH 1100 or CH 1110 or (CH 1150 and CH 1151) and MA 2160 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: Fall
Restrictions: May not be enrolled in one of the following Class(es): Graduate

ENG 3990 - 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

ENG 4160 - Teaching Methods in Technology and Design
Course intended for students pursuing technology and design secondary teacher certification. Students enroll in this course during the semester of their directed teaching.
Credits: 1.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: On Demand
Co-Requisite(s): ED 4710

ENG 4510 - Sustainable Futures I
Covers introductory and intermediate concepts of Sustainable Development. Explores methods/tools for assessing sustainability (economic, environmental, societal impacts) of current and emerging industrial technologies. Explores relationships between government policies and markets for introducing sustainable technologies into national economies and corporations.
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): UN 2002

ENG 4900 - Multidisciplinary Senior Design Project I
Introduction to engineering design, including modeling, simulation, economic decision making, and reliability. Integration of design principles in the solution of open-ended engineering problems. Projects are defined and planned with faculty and industrial guidance. Emphasizes economics and environmental constraints. Students must be Senior Project ready as defined by major.
Credits: 3.0
Lec-Rec-Lab: (0-1-6)
Semesters Offered: Fall, Spring, Summer
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

ENG 4905 - Engineering Design Project
Students complete a multidisciplinary engineering design project. Students must be Senior Project ready as defined by major. Not open to students who have taken ENG4900 or ENG4910.
Credits: 3.0
Lec-Rec-Lab: (0-2-3)
Semesters Offered: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

ENG 4910 - Multidisciplinary Senior Design Project II
Continuation of ENG4900. Introduction to engineering design including modeling, simulation, economic decision making and reliability. Integration of design principles in the solution of open-ended engineering problems. Projects are defined and planned with faculty and industrial guidance. Emphasizes economics and environmental constraints. (Senior project ready as defined by major substitutes for prerequisites)
Credits: 3.0
Lec-Rec-Lab: (0-1-6)
Semesters Offered: Fall, Spring, Summer
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior
Pre-Requisite(s): ENG 4900

ENG 4990 - Special Topics in Engineering
Engineering topics of interest to students and faculty that are not normally covered in the existing courses.
Credits: variable to 3.0, Repeatable to a Max of 6
Semesters Offered: On Demand

ENG 5100 - The Engineering Process
This course introduces the engineering problem solving and design processes. Students will learn about the engineering profession and will complete a design/build/test project.
Credits: 4.0
Lec-Rec-Lab: (0-3-2)
Semesters Offered: Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate

ENG 5101 - Introduction to Engineering for Educators I
Course is aimed at inservice teachers to provide them with an introduction to the engineering profession.
Credits: 2.0
Lec-Rec-Lab: (0-0-6)
Semesters Offered: Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate

ENG 5102 - Introduction to Engineering for Educators II
Course aimed at inservice teachers to provide them with further exposure to engineering applications in math and science.
Credits: 2.0
Lec-Rec-Lab: (0-0-6)
Semesters Offered: Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate

ENG 5200 - Engineering Applications in the Physical Sciences
This class will show how engineers use principles from the physical sciences to solve problems and design systems. Key concepts will be linked to the Michigan Curriculum Frameworks for precollege education.
Credits: 4.0
Lec-Rec-Lab: (0-3-2)
Semesters Offered: Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): ENG 5101

ENG 5201 - Introduction to Engineering in the Physical Science I
Course aimed at inservice teachers to provide them with exposure to engineering applications in the Physical Sciences.
Credits: 2.0
Lec-Rec-Lab: (0-0-6)
Semesters Offered: Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): ENG 5100 or (ENG 5101 and ENG 5102)

ENG 5202 - Introduction to Engineering in the Physical Sciences II
Course aimed at inservice teachers to provide them with further exposure to engineering applications in the Physical Sciences.
Credits: 2.0
Lec-Rec-Lab: (0-0-6)
Semesters Offered: Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): ENG 5201

ENG 5300 - Engineering Applications in the Earth Sciences
This course will show how engineers use principles from the earth sciences to solve problems and design systems. Key concepts will be linked to the Michigan Curriculum Frameworks for precollege education.
Credits: 4.0
Lec-Rec-Lab: (0-3-2)
Semesters Offered: Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): ENG 5100

ENG 5301 - Introduction to Engineering in the Earth Sciences I
Course aimed at inservice teachers to provide them with exposure to engineering applications in the Earth Sciences.
Credits: 2.0
Lec-Rec-Lab: (0-0-6)
Semesters Offered: Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): ENG 5100

ENG 5302 - Introduction to Engineering in the Earth Sciences II
Course aimed at inservice teachers to provide them with further exposure to engineering applications in the Earth Sciences.
Credits: 2.0
Lec-Rec-Lab: (0-0-6)
Semesters Offered: Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): ENG 5301

ENG 5510 - Sustainable Futures I
Explores methods/tools for assessing sustainability (economic, environmental, societal impacts) of current and emerging industrial technologies. Explores relationships between government policies and markets for introducing sustainable technologies into national economies and corporations.
Credits: 3.0
Lec-Rec-Lab: (3-0-6)
Semesters Offered: Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate

ENG 5511 - Sustainable Futures II
Covers introductory and intermediate concepts of Sustainable Development. Explores methods/tools for assessing sustainability (economic, environmental, societal impacts) of current and emerging industrial technologies. Explores relationships between government policies and markets for introducing sustainable technologies into national economies and corporations.
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): UN 2002

ENG 5510 - Sustainable Futures I
Explores methods/tools for assessing sustainability (economic, environmental, societal impacts) of current and emerging industrial technologies. Explores relationships between government policies and markets for introducing sustainable technologies into national economies and corporations.
Credits: 3.0
Lec-Rec-Lab: (3-0-6)
Semesters Offered: Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): ENG 5301

ENG 5511 - Sustainable Futures II
Covers introductory and intermediate concepts of Sustainable Development. Explores methods/tools for assessing sustainability (economic, environmental, societal impacts) of current and emerging industrial technologies. Explores relationships between government policies and markets for introducing sustainable technologies into national economies and corporations.
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): UN 2002
ENG 5520 - Sustainable Futures II
Covers sustainability in developed and developing countries. Topics include policy analysis, regulatory impact & cost benefit analyses, trade & markets, laws & regulations, international disasters, GIS applications, green manufacturing, and evolution of environmental policy in U.S. and other countries.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring

ENG 5530 - Graduate Colloquium in Sustainability
Introduces students to general and specific issues related to sustainability. Topics include review and discussion of historical readings that define the movement towards sustainability, international issues related to sustainable development, corporate leadership, consumption, and societal issues.
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall, Spring

ENG 5900 - Engineering Internship for Educators
Students will work in an industry or research internship during summer months with an engineer. At the conclusion of the internship, students will write a paper regarding how they will apply what they have learned in their pre-college classroom.
Credits: variable to 6.0; Repeatable to a Max of 6
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): ENG 5100 or (ENG 5101 and ENG 5102)

ENG 5998 - Engineering Design Practicum
An advanced independent study for students in the Master of Engineering program. In consultation with his/her advisor, the student develops and executes a project demonstrating capabilities in problem solving, communications, and decision making. The practicum can be completed on or off campus.
Credits: variable to 4.0; Repeatable to a Max of 4
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following College(s): College of Engineering

Enterprise

ENT 1950 - Enterprise Orientation
An orientation for students to the Enterprise program. Students will evaluate and participate with several different enterprise teams as a way to familiarize themselves with the program, teams, and students through hands-on project activities.
Credits: 1.0; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-1)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Class(es): Junior, Senior

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; an evaluation of learning and personality preferences; and exploring the MTU challenge course.
Credits: 1.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Fall, Spring, Summer

ENT 2950 - Enterprise Project Work I
An orientation for students to their specific enterprise. Covers enterprise specific topics but should include organizational structure; past, present, and future projects and their results; an evaluation of learning and personality preferences; and exploring the MTU challenge course.
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 2950 - Enterprise Project Work II
Interdisciplinary teams work as part of an engineering enterprise to address real-world engineering design projects or problems. Second-year students are responsible for achieving some prescribed objectives and performing critical analysis of data.
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 2964 - Machine Tool Fundamentals and Applications
Basic machine processes including setup and operation of lathes, milling machines, drill presses, grinder and saws. Students are exposed to fundamental machining processes, nomenclature, and machine operation with an overall focus on quality control and safety.
Credits: 1.0
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall

ENT 3950 - Enterprise Project Work III
Interdisciplinary teams work as part of an engineering enterprise to address real-world engineering design projects or problems. Third-year students will practice design 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

ENT 3954 - Enterprise Market Principles
Fundamental principles of marketing in a lecture format augmented by a simulation played in small groups. The course is completed in two day-long, Saturday sessions separated by one week. Examines 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
Restrictions: Permission of instructor required; 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: May not be enrolled in one of the following Major(s): Engineering, Civil Engineering, Chemical Engineering, Materials Science and Engrg, Electrical Engineering, Environmental Engineering, Geologic Engineering, Mechanical Engineering, Biomedical Engineering, Computer Engineering; May not be enrolled in one of the following Class(es): Freshman

ENT 3957 - Fundamentals of Engineering & Technology
Course provides an overview of the major activities involved in developing a product or service which will satisfy the customer. Introduces major engineering tools used for team-based integrated product/process development (IPPD) such as project management, benchmarking, quality function deployment, process flow charting, cost analysis, and failure modes and effects analysis.
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Major(s): Engineering, Civil Engineering, Chemical Engineering, Materials Science and Engrg, Electrical Engineering, Environmental Engineering, Geologic Engineering, Mechanical Engineering, Biomedical Engineering, Computer Engineering; May not be enrolled in one of the following Class(es): Freshman

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 life 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 3960 - Enterprise Project Work IV
Interdisciplinary teams work as part of an engineering enterprise to address real-world engineering 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
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 UN 2002

ENT 3962 - Communication Strategies
Drawing on the broad understanding of workplace communication developed in ENG 2962, 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: Spring

Pre-Requisite(s): ENT 2962 and (UN 1002 or UN 1003)

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 Gannt 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 teams, their structure, and interactions.

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): ENT 2962

ENT 3965 - 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 - Fundamentals of Product/Process Development
This course provides an overview of the major activities involved in developing a product or service which will satisfy the customer. The course introduces tools used for team-based integrated product/process development (IPPD) and cost-effective development of manufacturing processes including lean manufacturing and six sigma principles.

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 engineering enterprise.

Credits: 1.0; May be repeated
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall, Spring
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 3972 - Practical Electronic Circuit Design and Fabrication
This is a hands-on laboratory course that focuses on practical implementation of electronic circuits, especially for students enrolled in the Enterprise Program. Topics include grounding, wiring, analog/digital circuits, power supplies, EMC, board layout/fab/test, soldering, safety and instrumentation.

Credits: 1.0
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring
Restrictions: Permission of instructor required

ENT 3973 - Introduction to Geohydrological Characterization Techniques
Students will have the opportunity to conduct geohydrologic field work and apply the principles observed in the field to mathematical models. They will learn basic hygienic-oriented analytical techniques for evaluating well water. The course will require a weekend field excursion.

Credits: 1.0
Lec-Rec-Lab: (0-0-1)
Semesters Offered: Fall, Spring

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: (0-1-0)
Semesters Offered: Fall

Pre-Requisite(s): CH 1100 or CH 1110 or CH 1112 or (CH 1150 and CH 1151)

ENT 3975 - Introduction to Vehicle Design and System Modeling
Enterprise module introduces students to vehicle design process and system modeling. Students will be shown the formulation of math based models of systems and will use MATLAB as the computing engine. Computing applications include matrices, arrays, logical operators, program control flow, looping, iterative solutions and output manipulation including two and three dimensional graphics. The course is presented in an interactive Lecture/Computer Laboratory format. Theory is developed for each topic, demonstrated in MATLAB and example problems are solved by students using MATLAB during the period.

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): ENG 1102

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 YU 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)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior

Pre-Requisite(s): CH 1150 and CH 1151

ENT 3977 - Fundamentals of Hydrogen as an Energy Carrier
This course provides an overview of traditional and alternative energy sources, with particular emphasis on hydrogen energy. Discussion of energy production and sources; electric and hydrogen vehicles; production, distribution, and policy of hydrogen and the hydrogen economy.

Credits: 1.0
Lec-Rec-Lab: (1-0-0)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): CH 1100 or CH 1110 or (CH 1150 and CH 1151) and PH 2200

ENT 3978 - Hydrogen Measurements Laboratory
This course provides an introduction to basic experiments and measurements that relate to hydrogen and hydrogen powered fuel cells. Includes chemical and electrical safety, fuel cell operation and introduction to fuel cell integration into practical applications.

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

Pre-Requisite(s): PH 2200 and CH 1150 and CH 1151

ENT 4900 - Senior Enterprise Project Work I for Non-Engineering Majors
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 non-engineering majors.

Credits: 2.0
Lec-Rec-Lab: (0-0-6)
Semesters Offered: Fall, Spring
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

Pre-Requisite(s): Must be enrolled in one of the following Class(es): Junior, Senior
ENT 4910 - Senior Enterprise Project Work II for Non-Engineering Majors
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 non-engineering majors.
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
Interdisciplinary teams work as part of an engineering enterprise to address real-world engineering 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: 1.0
Lec-Rec-Lab: (0-0-6)
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required; Must be enrolled in one of the following College(s): College of Engineering; Must be enrolled in one of the following Major(s): Civil Engineering, Chemical Engineering, Software Engineering, Electrical Engineering, Environmental Engineering, Mechanical Engineering, Materials Science and Engineering, Biomedical Engineering, Computer Engineering; Must be enrolled in one of the following Class(es): Senior
Pre-Requisite(s): ENGR 3960 (C) or (ME 3910 (C) and ME 3910) or (ME 3920 (C) and ME 3920) or (ME 3930 (C) and ME 3930)

ENT 4951 - Business Plans and Budgeting in the Enterprise
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

ENT 4952 - Complex Communication Practices
Students apply strategies and knowledge learned in ENG2962 and ENG3962 to the achievement of more complex communication practices demanded in technical and professional environments. Emphasis is on professional identities, management communication skills, and responsible messages within teams and organizations and for a variety of technical and nontechnical audiences.
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall, Summer
Pre-Requisite(s): ENT 3962 and (UN 1002 or UN 1003)

ENT 4954 - Global Competition
Emphasizes unique economic, market, and political risks faced by organizations as operations expand beyond domestic borders. Discusses establishing risk profiles to analyze new labor, product, capital markets on a global scale and appropriate market entry strategies. Small teams will do a risk profile and recommend market entry strategies for selected countries.
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall
Pre-Requisite(s): ENT 2961 and UN 2002

ENT 4960 - Enterprise Project Work VI
Interdisciplinary teams work as part of an engineering enterprise to address real-world engineering design projects or problems. Fourth-year students gain experience defining project objectives, planning strategies to achieve these objectives, and leading technical teams to accomplish project goals.
Credits: 2.0
Lec-Rec-Lab: (0-0-6)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Class(es): Senior
Pre-Requisite(s): ENT 4950

ENT 4961 - Enterprise Project Work VII
Course intended for students who have completed all project courses in Enterprise and who wish to continue with the program through graduation. Repeatable to a Max of 2
Credits: 1.0; Repeatable to a Max of 2
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Fall, Spring
Restrictions: Permission of instructor required; Must be enrolled in one of the following Class(es): Senior
Pre-Requisite(s): ENT 3950 and ENT 3960 and ENT 4950 and ENT 4960

ENT 4970 - Enterprise Special Topics
For the development of new, senior-level instructional modules in support of the engineering enterprise.
Credits: 1.0; May be repeated
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Class(es): Senior

English as a Second Language

ESL 0100 - Special Topics
For students of English as a second language; not for native speakers of English. Course is used to offer special topics in English or skills in the English language for which a demand develops.
Credits: variable to 4.0; Graded Pass/Fail Only
Semesters Offered: On Demand

ESL 0210 - Beginning Reading/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; comprehension of main ideas, structural details, and summary; critical-thinking skills.
Credits: 4.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-3-3)
Semesters Offered: Fall, Spring

ESL 0220 - Beginning Writing/ Grammar
For students of English as a second language; not for native speakers of English. Emphasis is on understanding sentence basics, paragraph structure, basic grammar. Students write sentences and paragraphs using present, past and future tense and participate in peer editing.
Credits: 4.0; Graded Pass/Fail Only
Lec-Rec-Lab: (0-3-3)
Semesters Offered: Fall, Spring

ESL 0230 - Beginning Listening/Speaking
For students of English as a second language; not for native speakers of English. Emphasis on basic pronunciation and listening comprehension in North American English; includes patterns of rhythm and intonation; and conversation practice.
Credits: 4.0; Graded Pass/Fail Only
Lec-Rec-Lab: (0-3-3)
Semesters Offered: Fall, Spring

ESL 0290 - 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; Graded Pass/Fail Only
Semesters Offered: On Demand

ESL 0296 - SMILE: Summer Intensive Language Experience
For students of English as a second language; not for native speakers of English. A Beginning Level, multiple skills course in reading/vocabulary, writing/grammar, listening/speaking, and American culture.
Credits: 6.0; Graded Pass/Fail Only
Lec-Rec-Lab: (0-4-5)
Semesters Offered: Summer

ESL 0310 - Intermediate Read/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, comprehension of main ideas and structural details, critical-thinking skills and class discussion. Students learn to take notes, outline and summarize.
Credits: 4.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-3-3)
Semesters Offered: Fall, Spring

ESL 0320 - Intermediate Writing/ Grammar
For students of English as a second language, not for native speakers of English. Emphasis is on writing essays using the process approach to writing and collaborative workshop approach to revision in writing academic essays.
Credits: 4.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-3-3)
Semesters Offered: Fall, Spring

ESL 0330 - Intermediate, Listening/Speaking
For students of English as a second language; not for native speakers of English. Emphasis is on writing essays using the process approach to writing and collaborative workshop approach to revision in writing academic essays.
Credits: 4.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-3-3)
Semesters Offered: Fall, Spring
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

ESL 0398 - SMILE: Summer Intensive Language Experience
For students of English as a second language; not for native speakers of English. An Intermediate Level, multiple skills course in reading/vocabulary, writing/grammar, listening/speaking, and American culture.
Credits: 6.0; Graded Pass/Fail Only
Lec-Rec-Lab: (0-4-5)
Semesters Offered: Summer

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

ESL 0410 - Advanced Reading/Vocabulary
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, vocabulary acquisition, note-taking, inferring, summarizing, critical thinking and discussion, and understanding American culture.
Credits: 4.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-3-3)
Semesters Offered: Fall, Spring

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: (0-0-2)
Semesters Offered: Fall, Spring
Pre-Requisite(s): ESL 0310

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: (0-0-2)
Semesters Offered: Fall, Spring
Pre-Requisite(s): ESL 0410

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
Pre-Requisite(s): ESL 0410

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
Pre-Requisite(s): ESL 0410

ESL 0420 - Advanced Writing/Grammar
For students of English as a second language, not for native speakers of English. Emphasis is on the process approach to writing, collaborative workshop approach to revision, and APA style documentation in writing academic essays and research paper.
Credits: 4.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-3-3)
Semesters Offered: Fall, Spring

ESL 0430 - Advanced Listening/Speaking
For students of English as a second language, not for native speakers of English. Emphasis on improving pronunciation; social and academic conversation; academic presentations.
Credits: 4.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-3-3)
Semesters Offered: Fall, Spring

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
Semesters Offered: On Demand

ESL 0491 - Transitional Level Writing
This course is designed for students of English as a second language, not for native speakers of English. Emphasis is on the writing skills needed for success in academic writing courses. Includes paraphrase, summary, writing from sources, avoiding plagiarism.
Credits: 4.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-4-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): ESL 0420

ESL 0492 - Transition Level Listen/Speak
This course is designed for students of English as a second language, not for native speakers of English. Emphasis is on improving pronunciation, speaking skills, negotiations of working in groups.
Credits: 4.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-4-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): ESL 0430

ESL 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 iBT, the internet-based 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
Pre-Requisite(s): ESL 0310 and ESL 0320 and ESL 0330

ESL 0496 - SMILE: Summer Intensive Language Experience
For students of English as a second language; not for native speakers of English. Accelerated multiple skills course on reading strategies, vocabulary acquisition, note taking, inferring, summarizing, critical thinking, class discussion, essay writing, American culture. Prepares students for academic study. Offered second half of summer semester.
Credits: 6.0; Graded Pass/Fail Only
Lec-Rec-Lab: (0-4-5)
Semesters Offered: Summer

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

ESL 0510 - Academic Support Writing/Grammar
For students of English as a second language; not for native speakers of English. Emphasis on improving academic reading and writing skills; includes grammar, summary, paraphrase, documentation, research writing.
Credits: 3.0; May be repeated; Graded Pass/Fail Only
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

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

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: 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
Visual and Performing Arts

FA 1010 - Film/Video/Stage Practicum I
The course allows the student to apply acting techniques to a fully realized production. Students explore performance through the production process including script analysis, rehearsals, and final performance/project. The student must audition and be cast in a production.
Credits: 1.0
Lec-Rec-Lab: (0-0-1)
Semesters Offered: Fall, Spring

FA 1662 - Introduction to Practicum
An introduction to hands-on creative and technical work in sound. Includes an orientation to local audio production facilities and procedures.
Credits: 1.0
Lec-Rec-Lab: (0-0-1)
Semesters Offered: Fall

FA 1664 - Introduction to Practicum II
Further introduction to hands-on creative and technical work in sound. The class complements FA1662 but does not require completion of FA1662 to enroll.
Credits: 1.0
Lec-Rec-Lab: (0-0-1)
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

FA 1702 - Lighting and Sound Technology
Overview of the basics of theatrical lighting, stage electrics, 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

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, pattern drafting, and pattern fitting alteration.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2008-2009 academic year

FA 2010 - Film/Video/Stage Practicum II
The course allows the student to apply acting techniques to a fully realized production. Students explore performance through the production process including script analysis, rehearsals, and final performance/project. The student must audition and be cast in a production.
Credits: 1.0
Lec-Rec-Lab: (0-0-1)
Semesters Offered: Fall, Spring
Pre-Requisite(s): FA 1010

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. Multi-media presentations and discussions illustrate classic principles while encouraging development of individual expression.
Credits: 3.0
Lec-Rec-Lab: (0-1-4)
Semesters Offered: Fall, Spring, Summer

FA 2080 - Presentation Skills
A study and practice of delivery skills in the communication process. Students strengthen communication skills on all levels from interpersonal to public speaking.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring

FA 2150 - Creative Drawing
Analyzes the visual principles and vocabulary of drawing. Students are trained to observe, distinguish, and relate to the visual world through the process of drawing. Through study of a variety of subjects, students discover how to see, compose, use materials of drawing, work intuitively, and criticize.
Credits: 3.0
Lec-Rec-Lab: (0-1-4)
Semesters Offered: Spring

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: (0-1-4)
Semesters Offered: Fall

FA 2300 - Two-Dimensional Design
Introduction to basic design, composition, and color theory through imagery and design in two-dimensional media. Equal emphasis placed on thought processes and manual skill. The organization of space in two dimensions is taught through a variety of methods and materials. Emphasizes creativity, inventiveness, and experimentation.
Credits: 3.0
Lec-Rec-Lab: (0-2-3)
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.
Credits: 3.0
Lec-Rec-Lab: (0-2-3)
Semesters Offered: Fall, Summer

FA 2330 - Art Appreciation
Gives a basic appreciation of several art media, of artists, creative and technical processes, and major works of art. Learn the elements of art and the organizing principles of design. Includes an in-depth exploration into the life and works of one major artist in each medium.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2009-2010 academic year

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 HBP 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 2430 - 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: (0-0-3)
Semesters Offered: Fall, Spring

FA 2450 - Music Theory I
Introduction to music fundamentals, including musical notation; major, minor and modal scales; intervals; and rhythm. Provides ear training and development of sight-singing capabilities. Introduces music writing, both manual and using computers. Utilizes Computer-Assisted Music Instruction lab.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Summer
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, Summer

FA 2600 - Acting I
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

FA 2610 - Acting II: Scene Study
An advanced studio course designed to permit application of various acting techniques. Students will learn to combine acting skills and script analysis to develop multidimensional characters.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall

FA 2620 - Acting for the Camera
Acting training that focuses on film and television media. Students learn how to produce the subtle performance that the camera most often requires and practice cold reading audition techniques, learning to give a convincing performance in a short time period.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring

FA 2630 - Michigan Tech Dance
Dance is a musical theatre dance class that will focus on teaching the various dance styles most commonly featured in contemporary musical theatre. The student dance company that will constitute this class will support musical theatre productions within the Department and perform dance concerts. Audition required.
Credits: 1.0; May be repeated
Lec-Rec-Lab: (0-0-3)
Semesters Offered: On Demand
Restrictions: Permission of instructor required

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: Fall - Offered alternate years beginning with the 2009-2010 academic year

FA 2650 - Audition Techniques
Students learn to prepare for the many types of auditions they may encounter in the professional world of performance through simulated audition situations, from the theatrical cattle-call to the screen test in film.
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 - Mainstage Theatre: Acting
Students selected to be members of the cast or to serve as assistant directors or stage managers for plays produced by the Department of Fine Arts may enroll in this class with the permission of the faculty director.
Credits: variable to 3.0; May be repeated
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required

FA 2661 - Mainstage Theatre: Crew
Open to students selected for the crew of a mainstage theatre production sponsored by the Department of Fine Arts. Positions on stage crews are open to all MTU students. Work assignments will be made by the technical director of the Department of Fine Arts.
Credits: variable to 3.0; May be repeated
Semesters Offered: Fall, Spring

FA 2662 - Mainstage: Sound Crew
Open to students selected for the sound crew of a mainstage production sponsored by the Department of Fine Arts. Positions on stage crews are open to all MTU students. Work assignments will be made by the Sound Designer of the Department of Fine Arts.
Credits: variable to 3.0; May be repeated
Semesters Offered: Fall, Spring

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 KCASTF, AES, USITT, and URTA.
Credits: 1.0; Repeatable to a Max of 6
Lec-Rec-Lab: (0-0-1)
Semesters Offered: Fall, Spring

FA 2670 - Marketing the Performer
Develops, through self-survey of interests and talents and practical exercises, self-marketing of skills. Includes creating market-sensitive resumes and performance portfolios and exploring private enterprise opportunities.
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: On Demand

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

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 2800 - Script Analysis
Students learn textual analysis of dramatic literature for theatre and film scripts. Textual analysis is the foundation for the creative activities of actors, directors, designers, and technicians.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring

FA 2830 - Voice and Articulation
An applied study of the use of voice. Students will work to develop a stronger, more articulate and dialect-free speech appropriate for professional careers. Spring course offering will be in alternate years beginning with Spring 2009.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2010-2011 academic year

FA 3000 - Fine 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
Semesters Offered: On Demand

FA 3010 - Film/Video/Stage Practicum III
The course allows the student to apply acting techniques to a fully realized production. Students explore performance through the production process including script analysis, rehearsals, and final performance/project. The student must audition and be cast in a production.
Credits: 1.0
Lec-Rec-Lab: (0-0-1)
Semesters Offered: Fall, Spring
Pre-Requisite(s): FA 1010 and FA 2010

FA 3080 - Presentation Skills II
The course builds on techniques learned in Presentation Skills I. From small proposals using PowerPoint, to international conferences incorporating live performance, slideshows, and interactive Internet communication, students will be prepared to address the most significant presentational situations.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): FA 2080 or HU 2830

FA 3150 - Life Drawing
Drawing the human form. Combines the elements and principles of drawing with observation and construction of the human form. Emphasizes proportion, structural framework, visual measurement, movement, and relationships. Students work in a variety of drawing media.
Credits: 3.0
Lec-Rec-Lab: (0-2-3)
Semesters Offered: Fall, Spring
Pre-Requisite(s): FA 2050 or FA 2150
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: (0-1-4)
Semesters Offered: Spring

FA 3300 - Three-Dimensional Design
Introduction to three-dimensional creative processes through expressive use and exploration of a wide range of materials and techniques based on current theories. Students study elements and organizing principles of art; three-dimensional drawing techniques; theories of architecture and interior design; and additive, subtractive, and experimental sculpture.
Credits: 3.0
Lec-Rec-Lab: (0-2-3)
Semesters Offered: Spring
Pre-Requisite(s): UN 1002 or UN 1003

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: (0-2-3)
Semesters Offered: Spring

FA 3330 - Art History I
The world history of art, sculpture, and architecture. Focuses from the Paleolithic period to the Renaissance. Discusses how art relates to religion and informs a more complete view of society and technology. Lecture/discussion/slides, group work, and presentations.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): UN 1002 or UN 1003

FA 3333 - Sculpture
Theory, tools, and media of sculpture. Focuses primarily on clay, plaster, metal, plastic, and multimedia for qualified students. Students must apply theory to studio projects and justify each project in writing.
Credits: 3.0
Lec-Rec-Lab: (0-1-4)
Semesters Offered: Fall

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: (0-2-3)
Semesters Offered: On Demand
Pre-Requisite(s): FA 3333

FA 3340 - Art History II
Survey of art in the Western world from the Renaissance to the 21st century. Emphasizes the characteristics of period style and the influence of the time on the artist.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): UN 1002 or UN 1003

FA 3400 - Keweenaw Symphony Orchestra
A university/community orchestra studying and performing orchestral literature, including the classics, contemporary, choral, orchestral, and pops. The orchestra performs three to four concerts each year, often featuring professional guest artists. Audition required.
Credits: 1.0; May be repeated
Lec-Rec-Lab: (0-0-3)
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
Lec-Rec-Lab: (0-0-3)
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
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Fall, Spring

FA 3510 - Concert Choir
A select ensemble made up of student and community singers studying and performing choral literature ranging from chant to avant garde compositions. Activities include campus and community performances and occasional regional and international tours. Audition required.
Credits: 1.0; May be repeated
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Fall, Spring

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
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Summer - Offered alternate years beginning with the 2009-2010 academic year
Pre-Requisite(s): UN 1002 or UN 1003

FA 3560 - Music History
Developments in Western music from antiquity to the present. Includes a brief examination of pre-Christian, medieval, and Renaissance music. Concentrates on musical development of the baroque, classical, romantic, and twentieth-century periods. Emphasizes the relationship between music expression and society, including non-Western influences.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring, Summer
Pre-Requisite(s): UN 1002 or UN 1003

FA 3562 - 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
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Summer

FA 3565 - Production Management
Procedures and skills for effective 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, Summer
Pre-Requisite(s): UN 1002 or UN 1003

FA 3661 - Mainstage Theatre: Management and Design
Open to students who take significant responsibility for aspects of major Fine Arts theatre 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 2661

FA 3662 - Mainstage: Sound Design
Open to students who take significant responsibility for sound on major a Fine Arts 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 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 or FA 3730 or FA 3750 or FA 3760

FA 3675 - Personal Finance for Performers
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 or FA 3730 or FA 3750 or FA 3760

FA 3676 - Stage Properties and Scenic Design
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 or FA 3730 or FA 3750 or FA 3760

FA 3680 - Period Acting Styles
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 or FA 3730 or FA 3750 or FA 3760

FA 3675 - Personal Finance for Performers
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 or FA 3730 or FA 3750 or FA 3760

FA 3700 - Scenic Design
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 or FA 3730 or FA 3750 or FA 3760

FA 3710 - Vocal Approaches for Theatre and Electronic Media
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 or FA 3730 or FA 3750 or FA 3760

FA 3720 - Design and Production
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 or FA 3730 or FA 3750 or FA 3760

FA 3730 - Scenic Design
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 or FA 3730 or FA 3750 or FA 3760

FA 3740 - Recording
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: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): FA 1702 and FA 3730

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/director 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): FA 1702

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/texture 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 2000-2001 academic year
Pre-Requisite(s): FA 1701

FA 3770 - Voice Production
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 or FA 3730 or FA 3750 or FA 3760

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 and (UN 1002 or UN 1003)

FA 3781 - Musical Theatre History
An in-depth examination of theatrical history from ancient Egypt through the eighteenth century. Studies how the interrelationships among technologies, ideologies, geography, history, architecture, politics, and social expectations affected theatre productions. Students will engage in group investigative research and reporting as well as individual study.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Major(s): Theatre & Electronic Media
Pre-Requisite(s): FA 1702 or UN 1002 or UN 1003

FA 3791 - Modern Theatre History
An in-depth examination of theatrical history from ancient Egypt through the eighteenth century. Studies how the interrelationships among technologies, ideologies, geography, history, architecture, politics, and social expectations affected theatre productions. Students will engage in group investigative research and reporting as well as individual study.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Major(s): Theatre & Electronic Media
Pre-Requisite(s): FA 1702 or UN 1002 or UN 1003

FA 3821 - Modern Theatre History
An in-depth examination of theatrical history from ancient Egypt through the eighteenth century. Studies how the interrelationships among technologies, ideologies, geography, history, architecture, politics, and social expectations affected theatre productions. Students will engage in group investigative research and reporting as well as individual study.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Major(s): Theatre & Electronic Media
Pre-Requisite(s): FA 1702 or UN 1002 or UN 1003

FA 3830 - American Musical Theatre
A multimedia examination of the development of American musical theatre from the late 1800s to the present, showing how this native theatrical form grew and how it mirrored the society of its time.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): FA 1702 or UN 1002 or UN 1003

FA 3880 - Readings in Dramatic Literature
An examination of dramatic literature with an emphasis on theatre production. Students will examine ten plays per 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: (0-1-0)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Major(s): Theatre & Electronic Media
Pre-Requisite(s): FA 1702 or UN 1002 or UN 1003
FA 4010 - Film/Video/Stage Practicum IV
The course allows the student to apply acting techniques to a fully realized production. Students explore performance through the production process including script analysis, rehearsals, and final performance/project. The student must audition and be cast in a production.
Credits: 1.0
Lec-Rec-Lab: (0-0-1)
Semesters Offered: Fall, Spring
Pre-Requisite(s): FA 1010 and FA 2010 and FA 3010

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 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: Fall, Winter, Spring
Restrictions: Permission of instructor required
Pre-Requisite(s): FA 2200 or FA 3200

FA 4300 - Advanced Sculpture Studio
Projects course in advanced three-dimensional design. Requires a written proposal indicating the nature of the project, theory supporting it, and source and availability of materials, equipment, and funds to facilitate its completion. Completed project is presented to the instructor with a written justification and all drawings and models.
Credits: variable to 6.0; Repeatable to a Max of 6
Semesters Offered: On Demand
Restrictions: Permission of instructor required
Pre-Requisite(s): FA 3333

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., Jaztec, 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 4510 - Special Topics - Advanced Sound Studio
Introduction to professional sound work. Students produce a professional product in studio or live sound. Emphasis is placed on solid engineering practice and documentation to produce a desired artistic goal developed with the artistic performers, producers, or users.
Credits: variable to 6.0; Repeatable to a Max of 12
Semesters Offered: On Demand
Restrictions: Permission of instructor required
Pre-Requisite(s): FA 1702 and FA 3730

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): FA 2600

FA 4670 - Stage Combat
Provides basic skills for participating in choreographed fight sequences on stage and in film, TV, and electronic media. Students will learn hand-to-hand combat techniques, as well as several types of weaponry techniques including broadsword, rapier, and dagger.
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: On Demand
Pre-Requisite(s): FA 2710

FA 4680 - Playing Shakespeare
Provides specialized experience in performing Shakespeare and other Elizabethan authors including manners, movement, language structure, meaning, and vocal dynamics.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2009-2010 academic year
Pre-Requisite(s): FA 2600 and FA 2610

FA 4730 - Advanced Sound Design
A study of the musicality of noise and texts and their integration in theatrical sound design, mixing, and mastering. Emphasis is on student creativity and critical listening. Develops further applications of artistic concepts introduced in FA 3730.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2006-2007 academic year
Pre-Requisite(s): FA 1702 and FA 3730

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: (0-0-3)
Semesters Offered: Fall, Spring
Co-Requisite(s): FA 4741
Pre-Requisite(s): FA 1702 and FA 3730

FA 4741 - Transducer Theory Lab
Laboratory to practice the application of loudspeaker and microphone principles. Designed to be taken concurrently with FA4740 Transducer Theory.
Credits: 1.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Fall, Spring
Co-Requisite(s): FA 4740

FA 4755 - Lighting for Business and Industry
Studies of lighting uses and methods in various non-theatrical environments, such as: museums, architecture, industry, displays, corporate events. Explores how theatrical lighting design techniques are adapted, aesthetic goals, effects on target audiences, types of lighting equipment used, and safety.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Pre-Requisite(s): FA 3750

FA 4800 - Jazz Improvisation
Explores the elements of jazz improvisation while developing creative ideas and technical facility in the individual musician. Emphasis will be placed on learning the idiomatic use of the major scale and associated modes, the jazz melodic minor scale, the blues scale, pentatonic scales, and the 8-tone dominant scale. Development of stylistic conformity by exploring the styles of swing, bebop, cool, blues, Latin and rock/funk. Emphasis on the II-V-I progression in major and minor keys and symmetric harmony.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2001-2002 academic year
Pre-Requisite(s): FA 3530 and (UN 1002 or UN 1003)

FA 4820 - Jazz Arranging
Explores elements of jazz arranging and composition while developing creative ideas in the individual musician. Emphasis on learning to arrange for jazz combo and traditional big band. Includes developing the shape concept of triad use, 4-part and 5-part chord voicing, construction of an arrangement, and competence with FINALE notational software.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2003-2004 academic year
Pre-Requisite(s): FA 2500 and FA 3530

FA 4900 - Independent Study: Research
Independent research directed by fine arts faculty. Projects focus on one or more of the fine arts genres (theatre, music, visual arts). Requires a written proposal setting out goals, plans for final project (e.g., research paper, research web site), and the resources required to complete the project.
Credits: variable to 6.0; Repeatable to a Max of 6
Semesters Offered: Fall, Spring
Restrictions: Permission of instructor required

FA 4910 - Independent Study: Studio
Guided independent study directed by fine arts faculty member(s) involving creating and performing new work in the areas of music, theatre, and visual arts. Requires a written proposal setting out goals, plans for final project, and the resources required to complete the project.
Credits: variable to 6.0; Repeatable to a Max of 6
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required
Forest Resources & Env Science

FW 4915 - Independent Study with CAML Access
Allows students to use the Fine Arts (CAML) Computer Lab while engaged in an independent study project supervised by a Visual and Performing Arts Department faculty member.

Credits: variable to 3.0; May be repeated

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required

FW 4950 - Special Topics in Fine Arts
Tutorial, seminar, or class study of a topic of special interest and importance in fine arts.

Credits: variable to 6.0; Repeatable to a Max of 6

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required

FW 4960 - Special Topics Workshop
Special workshop projects in the fine arts.

Credits: variable to 6.0; Repeatable to a Max of 6

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required

FW 4970 - Fine Arts Final Project
Capstone course extending the student's knowledge and skill in a chosen fine arts discipline through independent research or other focused creative activity. A detailed proposal of the student's final project must be approved in writing by a Visual and Performing Arts faculty advisor before the student enrolls in FA4970.

Credits: variable to 3.0

Semesters Offered: Fall, Spring, Summer

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

FW 4971 - Fine Arts Final Project with Computer Lab Access
Capstone course extending the student's knowledge and skill in a chosen fine arts discipline through independent research or other focused creative activity utilizing the Fine Arts Computer Lab. A detailed proposal of the student's final project must be approved in writing by a Visual and Performing Arts faculty advisor before student enrolls in FA4971.

Credits: variable to 3.0; May be repeated

Semesters Offered: Fall, Spring, Summer

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

FW 4972 - Fine Arts Final Project with Sound Studio Access
Capstone course extending the student's knowledge and skill in a chosen fine arts discipline through independent research or other focused creative activity utilizing the Fine Arts Sound Studio. A detailed proposal of the student's final project must be approved in writing by a Visual and Performing Arts faculty advisor before the student enrolls in FA4972.

Credits: variable to 3.0; Repeatable to a Max of 6

Semesters Offered: Fall, Spring

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

FW 4975 - Portfolio Presentation
A public presentation of an array of art work completed by a student as part of the minor in Art or a Visual and Performing Arts degree program. Guidelines for the portfolio presentation are available from the student's advisor.

Credits: variable to 3.0; Repeatable to a Max of 3

Semesters Offered: Fall, Spring

Restrictions: Permission of instructor required

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 - Natural Resources Seminar
Seminar introduces students to the various careers within forestry, conservation, ecology, and wildlife that represent specialties within natural resources.

Credits: 1.0

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

Semesters Offered: Spring

FW 2010 - Vegetation of North America
Identification of trees and shrubs. Study of seed dispersal, dormancy, seedbed requirements, shade tolerance, life span, and ecology, with an emphasis on trees. Systematic study of the major forested vegetation types of North America.

Credits: 4.0

Lec-Rec-Lab: (2-1-3)

Semesters Offered: Fall

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: 1.0

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

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

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: 1.0

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall

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
Gain a basic understanding of how forest ecosystems function across various temporal and spatial scales. Emphasizes real-world problems and the skills necessary to resolve land-use conflicts and to manage terrestrial ecosystems.

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
Basic concepts and practical applications of biotechnology and genetic engineering. Topics include advances and practical applications relating to improving quality and field performance of agricultural crops, environmental remediation, and phyto-pharmaceutics. Recent advances in gene containment, regulatory, societal and environmental issues associated with commercialization of genetically modified organisms 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: (1-0-3)

Semesters Offered: Fall

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

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

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

Pre-Requisite(s): FW 2051

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

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
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
Restrictions: May not be enrolled in one of the following Major(s): Forestry, Wildlife Ecology & Mgmt, App Ecol & Environ Sci
Pre-Requisite(s): FW 2051 and FW 3200 and FW 3200 and (MA 2710 or MA 2720 or MA 3710)

FW 3200 - Inventory, Monitoring 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 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: 3.0
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): BL 2200

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 1100(C) or CH 1110(C) or CH 1112(C) or (CH 1150(C) and CH 115(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 3378 - Forest & Environmental Resource Management (The FERM) III
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: 4.0; May be repeated
Lec-Rec-Lab: (0-4-0)
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 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 ARC/GIS software package.
Credits: 4.0
Lec-Rec-Lab: (3-0-3)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Major(s): App Ecol & Environ Sci, Forest Ecology & Mgmt, Wildlife Ecology & Mgmt, Forest Science, Forestry, For Molec Genetics & Biotec, Applied Ecology, Forestry
Pre-Requisite(s): MA 2710(C) or MA 2720(C) or MA 3710(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
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 3630 - Wildlife Habitat Diseases and Parasites
The ecological management of forest wildlife and how management influences wildlife populations. Laboratory introduces techniques in wildlife research and management, including habitat analysis. Includes detection and identification of wildlife diseases and parasites, and may include field trips to area landowners.
Credits: 4.0
Lec-Rec-Lab: (2-1-3)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following College(s): Sch of Forest Res & Envr Sci; 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 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

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
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
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 Economics and Finance
Financial analysis and economic theory applied to forestry project analysis and selection, focusing on prices. Covers risk, capital markets, taxation, auctions, and non-market valuation.
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

FW 4089 - Bioinformatics
Computer applications in molecular biology. Hands-on experience with popular computer programs for DNA, RNA, and protein sequence analysis. Learn database management, data editing, assembly, and organization. Covers multiple-sequence comparisons, protein structural analysis, evolutionary relationships of genes, and use of internet for data retrieval, comparison, and analysis.
Credits: 3.0
Lec-Rec-Lab: (2-0-2)
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, Sophomore

FW 4110 - Tree Seedling Production and Greenhouse Management
Demonstrates greenhouse culture of trees from seed or vegetative cuttings. Topics include production of containerized seedlings; vegetative propagation via budding, grafting, and rooting of cuttings; and genetic manipulation. Students have hands-on roles in the routine greenhouse culture, such as media preparation, pest management, and fertilization.
Credits: variable to 4.0
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

FW 4120 - Tree Physiology and Genetics
Introduction to the genetics and physiology of forest trees. Develops a basic understanding of how trees grow and develop and why they vary from tree to tree. Covers modern methods to improve forest trees.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring

FW 4140 - Vegetation Modeling
Use of models in research and management of terrestrial ecosystems. Teaches application with emphasis on philosophy; models as tools, design goals and approaches, and interpreting the meaning and significance of model outputs.
Credits: 2.0
Lec-Rec-Lab: (1-0-2)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): FW 3010 or FW 3012

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: Fall
Pre-Requisite(s): FW 3010 and FW 4080

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: Summer

FW 4200 - Wetlands
Study of the physical, chemical, and biological characteristics of 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 4240 - Mammmalogy
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
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): BL 1040

FW 4260 - Population Ecology
Covers the principles of population ecology. Topics include measures of populations, population dynamics, and models used to describe the theories related to population dynamics.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall

FW 4300 - Introduction 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: (3-0-0)
Semesters Offered: Spring

FW 4370 - Forest and 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 4380 - Landscape Ecology
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: Must be enrolled in one of the following Class(es): Junior, Senior

FW 4400 - Urban Forestry
Urban forestry covers the planting and maintenance of trees in urban settings. Presents modern arboriculture and tree care methods and discusses administration of urban forests. Topics covered include pest management, pruning, planting, fertilization, inventories, tree selection, and line clearance. Labs include experience in tree climbing, pruning, and planting.
Credits: 3.0
Lec-Rec-Lab: (2-0-3)
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 - Offered alternate years beginning with the 2006-2007 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

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: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): BL 1040 or BL 1020

FW 4634 - Conservation Issues in Yellowstone
Yellowstone has a rich, complex history of conservation challenges. This course will provide in-depth explorations of conservation controversies occurring in Yellowstone; first in an MTU classroom, followed by an 8 day visit to the park. Course takes place in summer; dates vary.
Credits: 6.0
Lec-Rec-Lab: (0-3-9)
Semesters Offered: Summer

FW 4638 - Wolf Ecology and Management
Covers wolf ecology, current status and management of wolf populations throughout the U.S., wolf/prey dynamics, and field techniques utilized in the study of wild wolves. Course begins in the classroom, followed by a 4-day field trip (camping), which includes observation of captive wolves at the International Wolf Center, experience locating wild wolves (radio telemetry, howling surveys, wolf sign in the field) and a visit with wolf researchers.
Credits: 3.0
Lec-Rec-Lab: (2-0-2)
Semesters Offered: Summer

FW 4810 - Integrated Resource Assessment
Provides a capstone experience by integrating techniques from many of the applied ecology and forestry core courses. Covers multi-resource inventory of forested landscapes; description and evaluation of the potential for providing various natural resource outputs; development of GIS information and applications, maps, and other descriptors useful in the analysis of diverse management alternatives.
Credits: 4.0
Lec-Rec-Lab: (0-3-3)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

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

FW 5000 - Distinguished Ecologist Lecture Series
An opportunity to meet with some of the world’s leading ecologists and to discuss their research. Pre- and post-lecture meetings enable students to review some of the research and discuss how it has impacted the field of ecology.
Credits: 1.0; May be repeated
Lec-Rec-Lab: (1-0-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Level(s): Graduate

FW 5020 - Identification & Biology of Forest Vegetation
Emphasis will be placed on survival and regeneration strategies of forest vegetation. Includes systematic study of the major forest vegetation types of North America. An independent project component may be required.
Credits: 2.0
Lec-Rec-Lab: (1-0-3)
Semesters Offered: Fall

FW 5032 - Integrated Forest Inventory and Data Analysis
Sampling approaches for estimating overstory, understory, wildlife, and abiotic attributes in forested ecosystems. Includes parameter estimation at different scales such as stand, forest, and landscape and emphasizes data management and statistical analysis techniques.
Credits: 3.0
Lec-Rec-Lab: (2-0-3)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate

FW 5070 - Developmental and Ecological Genetics
Course will provide current knowledge on signal perception, transduction and response pathways in higher eukaryotes with most examples primarily from but not limited to plants in a lecture and colloquium format. Topics will cover major developmental pathways, and molecular bases of adaptation to abiotic factors.
Credits: 3.0
Lec-Rec-Lab: (1-2-0)
Semesters Offered: Fall

FW 5080 - Gene Profiling Analysis
Advanced training in molecular techniques with an emphasis on gene expression analysis. Discussion of various gene profiling methods and their applications. Hands-on laboratory exercises and data analysis.
Credits: 3.0; Graded Pass/Fail Only
Lec-Rec-Lab: (0-2-3)
Semesters Offered: Spring
Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

FW 5085 - Functional Genomics and Biotechnology
Fundamentals and practical applications of functional genomics tools in biological research. Topics include transcript profiling, regulation of gene expression, mechanisms of gene silencing, genetic transformation, and high throughput DNA microarray and metabolic profiling technologies.
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, Junior

FW 5086 - Forest Finance & Economics
Financial analysis and economic theory applied to forestry project analysis and selection, focusing on prices. Covers risk, capital markets, taxation, auctions, and non-market valuation.
Credits: 3.0
Lec-Rec-Lab: (2-0-2)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate

FW 5089 - Tools of Bioinformatics
Computer applications in molecular biology. Hands-on experience with using popular computer programs for DNA, RNA and protein sequence analysis, database management, data editing, assembly, and organization, multiple sequence comparisons, protein structural analysis, evolutionary relationships of genes, use of Internet for data retrieval, comparison and analysis.
Credits: 4.0
Lec-Rec-Lab: (2-1-2)
Semesters Offered: Spring - Offered alternate years beginning with the 2005-2006 academic year
Restrictions: Must be enrolled in one of the following Level(s): Graduate

FW 5096 - Advanced Wood Processing
Wood is an abundant and widely-used raw material. Wood-based manufacturing plants in the upper midwest are toured during the week prior to the start of the Fall semester. Plant characteristics are discussed during class meetings.
Credits: 2.0
Lec-Rec-Lab: (1-0-3)
Semesters Offered: Fall

FW 5100 - Advanced Terrestrial Ecology
Structure and function of terrestrial ecosystems. Roles of ecotypic variation, animals, natural disturbance, biological diversity, management, and global change on plant community dynamics and ecosystem processes.
Credits: 3.0
Lec-Rec-Lab: (2-0-2)
Semesters Offered: Spring
Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

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FW 5109 - Ecophysiology of Global Change
Physiological responses of plant species to climatic variation and change, pollutant deposition and altered atmospheric conditions; potential future changes in the distribution and function of species, communities and ecosystems.
Credits: 3.0
Lec-Rec-Lab: (2-0-2)
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, Junior

FW 5111 - Advanced Natural Resource Policy
This course surveys basic important federal policies related to water, land, forest, mineral, and wildlife and fisheries management. It uses policy analysis tools to understand the theory and study of policy development and implementation.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2009-2010 academic year
Restrictions: Must be enrolled in one of the following Level(s): Graduate

FW 5115 - Restoration Ecology
Study the tools, challenges, and philosophical underpinnings associated with ecological restoration. Restoration of forest, grassland, and wetland communities (plant and animal) will be discussed.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2004-2005 academic year
Restrictions: Must be enrolled in one of the following Level(s): Graduate

FW 5130 - Forest Vegetation Dynamics
Investigation of how trees grow and interact in a variety of stand structures from a functional standpoint at both the tree- and stand-level. These principles will be used to test the use of silvicultural management tools for meeting a variety of objectives. Linkages will be made between stand development patterns and management options, with an emphasis on disturbance ecology.
Credits: 3.0
Lec-Rec-Lab: (2-1-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2004-2005 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): BL 3400 or FW 3010 or FW 3012 or FW 3020

FW 5150 - Institutions and Natural Resource Management
Examines how institutions manage natural resources to meet their legal and social requirements and the demands of constituencies. Emphasis is on case study application.
Credits: variable to 3.0; Repeatable to a Max of 3
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following College(s): Sch of Forest Res & Envir Sci

FW 5180 - Philosophy and Ethics of Conservation and Ecology
Examines how institutions manage natural resources to meet their legal and social requirements and the demands of constituencies. Emphasis is on case study application.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2004-2005 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): BL 3400 or FW 3010 or FW 3012 or FW 3020

FW 5210 - Organisms and Their Environment
Studies the quantitative exchange of radiation, heat, mass and momentum between the atmosphere, vegetation, and soils with an emphasis on forest processes. Other topics include the physical and biological controls of water vapor exchange and carbon dioxide exchange, models of stand-scale evaporation, transpiration, photosynthesis and respiration.
Credits: 2.0
Lec-Rec-Lab: (2-0-2)
Semesters Offered: Fall - Offered alternate years beginning with the 2007-2008 academic year
Restrictions: Must be enrolled in one of the following Level(s): Graduate

FW 5221 - Advanced Wetland Science
Advanced study in wetland ecology concentrating on theoretical and technological advances. Readings will pertain to major topics in wetland ecology: hydrology, soils, vegetation, biogeochemistry, and ecological characteristics of different wetland types.
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Level(s): Graduate

FW 5350 - Soil Biology
Ecology of soil microorganisms and fauna and their roles in soil organic matter decomposition and nutrient cycling.
Credits: 4.0
Lec-Rec-Lab: (3-1-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2000-2001 academic year
Pre-Requisite(s): FW 3330 or BL 3210

FW 5375 - Advanced Forest and Environmental Resource Management I
Application of forest and environmental management practices and topical investigations 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: 1.0; May be repeated
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate

FW 5377 - Advanced Forest & Environmental Resource Management II
Application of forest and environmental management practices and topical investigations 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
Restrictions: Must be enrolled in one of the following Level(s): Graduate

FW 5410 - Analysis of Natural Resource Data
Design and analysis of univariate experiments using analysis of variance (ANOVA) and related techniques. Topics covered include factorial experiments and use of blocking and covariance analysis to control experimental error.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2004-2005 academic year
Restrictions: Must be enrolled in one of the following Level(s): Graduate

FW 5411 - Applied Regression Analysis
Regression as a tool for the analysis of forest and environmental science data. Topics include multiple linear, curvilinear and non-linear regression, hierarchical and grouped data and mixed-effects models. Emphasis is placed on application of tools to real-world data.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2004-2005 academic year
Restrictions: Must be enrolled in one of the following Level(s): Graduate

FW 5412 - Regression with the R Environment for Statistical Computing
Use of R for basic data manipulation, statistical summary and regression. Topics include installing R, data import and export, basic statistics, graphics and fitting of linear, non-linear and mixed-effects models.
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2004-2005 academic year
Restrictions: Must be enrolled in one of the following Level(s): Graduate

FW 5411 - Applied Regression Analysis
Regression as a tool for the analysis of forest and environmental science data. Topics include multiple linear, curvilinear and non-linear regression, hierarchical and grouped data and mixed-effects models. Emphasis is placed on application of tools to real-world data.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2004-2005 academic year
Restrictions: Must be enrolled in one of the following Level(s): Graduate

FW 5510 - Special Topics in Natural Resources
Independent study of a specific area of natural resources.
Credits: variable to 9.0; Repeatable to a Max of 9
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate

FW 5540 - Advanced Terrestrial Remote Sensing
Remote sensing principles and concepts at the graduate level. Topics include camera and digital sensor arrays, types of imagery, digital data structures, spectral reflectance curves, applications and introductory digital image processing.
Credits: 4.0
Lec-Rec-Lab: (2-1-3)
Semesters Offered: Fall - Offered alternate years beginning with the 2008-2009 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior
FW 5550 - Geographic Information Systems for Resource Management

Use of geographic information systems (GIS) in resource management. Studies various components of GIS in detail, as well as costs and benefits. Laboratory exercises use ArcGIS software package to solve resource management problems.

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, Junior
Pre-Requirement(s): MA 2710 or MA 2720 or MA 3710

FW 5560 - Digital Image Processing: A Remote Sensing Perspective

Presents the theory and quantitative procedures of digital image processing using remotely sensed data. Emphasizes image acquisition, preprocessing, enhancement, transformation classification techniques, accuracy assessment, and out-products. Discusses linkages to GIS. Also covers evaluating applications of the technology to current resource management problems via peer-reviewed literature.

Credits: 4.0
Lec-Rec-Lab: (3-0-3)
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, Sophomore, Junior
Pre-Requirement(s): FW 5540

FW 5620 - Herpetology

The biology of amphibians and reptiles, including evolution, zoogeography, ecology, behavior and physiology.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2007-2008 academic year
Restrictions: Must be enrolled in one of the following Level(s): Graduate

FW 5641 - Global Change Institute for Teachers

This course will provide teachers with the skills necessary to engage middle/high school students in real-world study of global climate change and its effects on ecosystems. National Content Standards for mathematics and life, earth and physical sciences will be addressed.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Summer

FW 5700 - Graduate Field Forestry

For graduate students without an undergraduate degree in forestry or a closely related field. Covers field skills in mapping/GPS work, forest diseases and insects, wildlife, timber harvesting, natural resource inventory, and silviculture for graduate students without an undergraduate degree in environmental science or a closely related degree.

Credits: 8.0
Lec-Rec-Lab: (3-0-15)
Semesters Offered: Fall

FW 5701 - Graduate Field Applied Ecology

Field skills in mapping/GPS work, forest diseases and insects, wildlife, vegetation geomorphology, natural resource inventory and silviculture for graduate students without an undergraduate degree in environmental science or a closely related degree.

Credits: 8.0
Lec-Rec-Lab: (3-0-15)
Semesters Offered: Fall

FW 5710 - Trees in Agricultural Systems

Farm systems analysis and the role of trees in tropical farming systems. Also covers specific material on soil conservation and tropical crops.

Credits: 2.0
Lec-Rec-Lab: (2-0-0)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

FW 5720 - International Forestry Seminar

Seminar for students who have completed FW5730. Synthesizes field work in a theoretical framework. Covers macro aspects of development theory.

Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requirement(s): FW 5730

FW 5730 - Field Work in International Forestry

Field work and reporting from students in the Peace Corps Loret Miller Ruppe Masters International Program in Forestry.

Credits: 1.0; May be repeated
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

FW 5740 - Overseas Research

An introduction to conducting research overseas. Covers scientific methods, ethics, and responsibilities in other cultures, social research, and research development.

Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall
Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

FW 5750 - Graduate Tropical Forestry

Fundamental ecological processes in tropical forests, traditional use including tenure, current problems and solutions to those problems.

Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall
Restrictions: Permission of instructor required; May not be enrolled in one of the following Class(es): Freshman, Sophomore

FW 5770 - Rural Community Development Planning and Analysis

Context, analysis, and monitoring of development processes of rural communities in tropical countries.

Credits: 2.0
Lec-Rec-Lab: (2-0-0)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

FW 5800 - Master's Graduate Seminar

Presentation by students of current forest resource-related problems and research. Some instruction on presentation skills.

Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate

FW 5810 - Research Methods in Natural Resources

Overview of science and scientific research. The process of graduate education including choosing an advisor, selecting a research problem, writing a thesis proposal, scientific hypothesis testing, analyzing data, and communicating results through various media.

Credits: 2.0
Lec-Rec-Lab: (2-0-0)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate

FW 5850 - Effective Grantsmanship Workshop

Ability to write successful grant application is an important part of graduate education. Students will learn basic techniques of grant writing for federal, industrial, and international funding agencies and will submit a well-organized proposal for peer review in the class.

Credits: 3.0
Lec-Rec-Lab: (1-2-0)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

FW 5975 - Full Time Master's Research

Open to students who have successfully completed all the required courses as well as the required number of credits for the master's degree. Students in this course are involved in full-time research. Tuition for this course is charged at the graduate full-time research rate. Students enrolled in this course may not register for any other course.

Credits: 9.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-9-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

FW 5998 - Forest Resources and International Forestry Master's Research

An original investigation in theoretical or experimental natural resources and submission of a thesis or report in partial fulfillment of the requirements of the Master of Science degree conducted while in a Peace Corps program.

Credits: variable to 9.0
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following College(s): Sch of Forest Res & Envir Sci

FW 5999 - Forest Resources and Environmental Science Master's Research

An original investigation in forest science, ecology, and forest molecular genetics that culminates in a Master's degree.

Credits: variable to 15.0; May be repeated; Graded Pass/Fail Only
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate
FW 6800 - Doctoral Graduate Seminar
A seminar course in which current forest resource related problems and research are presented by students in the class. Some instruction on presentation skills.
Credits: 1.0; Repeatable to a Max of 2
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate

FW 6975 - Full-Time Doctoral Research
Open to students who have successfully completed all required courses as well as the comprehensive and proposal defense exams. Students in this course are involved in full-time research. Tuition for this course is charged at the graduate full-time research rate. Students enrolled in this course may not register for any other course.
Credits: 9.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-9-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

FW 6980 - Graduate Teaching
Development of teaching skills through assisting in instruction. Students gain experience in course organization, lecture and laboratory instruction, and laboratory preparation.
Credits: variable to 4.0; Repeatable to a Max of 4; Graded Pass/Fail Only
Lec: (0-0-3)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate

FW 6999 - Forest Resources and Environmental Science Doctoral Research
An original investigation in theoretical or experimental natural resources and submission of a dissertation in partial fulfillment of the requirements of the PhD degree.
Credits: variable to 15.0; May be repeated; Graded Pass/Fail Only
Lec: (0-9-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate

GE 1100 - Geological Engineering and Sciences Orientation
Introduction to geosciences as a profession, including discussions of career opportunities and geosciences 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 geosciences program.
Credits: 1.0; Graded Pass/Fail Only
Lec: (0-0-3)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Major(s): Geological Engineering, Sciences & Arts Undeclared, Engineering Undeclared, General Sciences and Arts, Applied Geophysics, Geology; May not be enrolled in one of the following Class(es): Junior, Senior

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, 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: (2-0-3)
Semesters Offered: Spring

GE 2300 - Earth Materials I: Mineralogy
Identification, physical properties, chemistries, structures, uses, and occurrences of minerals. Laboratory includes hand specimen and x-ray diffraction identification of minerals.
Credits: 3.0
Lec-Rec-Lab: (2-0-3)
Semesters Offered: Fall
Pre-Requisite(s): GE 2000 and CH 1100 or CH 1110 or (CH 1150 and CH 1151)

GE 2310 - Earth Materials II: Rocks and Mineral Resources
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 2800 - Water and Society
The course introduces basic concepts of the water cycle, human interactions in the water cycle, and the social and political dimensions of water. Areas of coverage include: hydrology, water economics, water law, water and politics, water and religion, and water and health.
Credits: 3.0
Lec-Rec-Lab: (2-0-2)
Semesters Offered: Fall
Pre-Requisite(s): UN 2002

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
Study of structural geology and regional settings resulting from the application of deforming forces, including the geometry, origin, 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: Fall
Pre-Requisite(s): CH 1100 or CH 1110 or (CH 1150 and CH 1151)
GE 3250 - Computational Geosciences
Introduction to quantitative analysis and display of geologic data using Matlab and Excel, covering basic 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 geospatial 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 1161

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 preventive and corrective actions.
Credits: 1.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Summer

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 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 - Geological 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 4050 - Advanced Structural Geology
How rocks deform on a microstructural to hand specimen scale. Topics include dislocations, work hardening and recovery processes, annealing and recrystallization, slip systems, preferred orientation mechanisms, and foliation development.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: On Demand
Pre-Requisite(s): GE 3050

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 3050

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 and UN 2002

GE 4250 - Fundamentals of Remote Sensing
This course focuses on the basic physics behind 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): GE 2000 or GE 2100

GE 4360 - 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 2200 and MA 2160

GE 4450 - Advanced Environmental Geophysics
Covers the principles, design, and practice of geophysical site investigation utilizing electrical and electromagnetic techniques with emphasis on near surface application pertinent to the environmental consulting industry.
Credits: 3.0
Lec-Rec-Lab: (2-0-3)
Semesters Offered: Fall
Pre-Requisite(s): GE 3040

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, Spring
Pre-Requisite(s): MA 3160 and PH 2200 and GE 2000
GE 4550 - Gravity and Magnetic Interpretation Methods
Interpretation of gravity and magnetic anomalies based on forward modeling techniques, including space filtering to enhance anomalies of importance. Emphasis will also be given to the design of the gravity/magnetic survey based on cost, implementation, and interpretation methods used.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring - Offered alternate years beginning with the 2004-2005 academic year
Pre-Requisite(s): GE 3040

GE 4560 - Earthquake Seismology
Physics of earthquakes and seismic energy propagation including stress and strain, elastic wave equation, body and surface waves, anelasticity, anisotropy, earthquake location, earthquake sources, passive seismic imaging. Homework will require computer skills in Matlab or similar.
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 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 logs 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

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) and UN 2002

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 2002

GE 4700 - Geologic Mapping of Remote Terrain
Introduces students to the art and science of producing a geologic map for virtually any area of the world using satellite data and modern software and tools.
Credits: 3.0
Lec-Rec-Lab: (0-2-1)
Semesters Offered: Spring
Restrictions: Permission of department required

GE 4750 - Subsurface Mapping of Petroleum Prospects
Extensional, wrench and compressional features that produce petroleum traps including subsurface geological mapping. Lab topics include fault surface mapping; fault bifurcations, intersections, and terminations; structural integration; and volumetrics of bottom water, edge water, and fault wedge reservoirs.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Pre-Requisite(s): GE 3050

GE 4760 - Mining Geology
Exploration, geologic evaluation, and mining of mineral resources with emphasis on metals. An integrated engineering evaluation project includes factors such as geologic characteristics, design of exploration of program, design of drilling program, resource estimation, reporting requirements, mining methods, engineering economics, environmental impact, and mine permitting.
Credits: 3.0
Lec-Rec-Lab: (2-0-3)
Semesters Offered: Fall
Pre-Requisite(s): GE 2310 and GE 3050 and GE 3910

GE 4800 - Groundwater Engineering
Application of geohydrology 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-Requisite(s): GE 3850

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
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: Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior
Pre-Requisite(s): GE 4900

GE 4915 - Field Geology Excursions in Michigan's Upper Peninsula
Three week course which provides background necessary to understand several field sites visited as part of course. Participants are encouraged to lead other groups, particularly school groups, on visits to these sites as part of their own teaching activities.
Credits: 3.0
Lec-Rec-Lab: (0-0-9)
Semesters Offered: Summer

GE 4916 - Field Geology in East 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: 5.0
Lec-Rec-Lab: (0-0-15)
Semesters Offered: Summer
Restrictions: Permission of instructor required
Pre-Requisite(s): GE 3050

GE 4917 - Geology of East Africa
Introduction to geology of East Africa. Intended for students with an interest in geological sciences. Requires paper(s) and digital scrapbook.
Credits: 4.0
Lec-Rec-Lab: (0-0-12)
Semesters Offered: Summer
Restrictions: Permission of instructor required

GE 4918 - Geology and Field Excursion to Canada Preparation
The geology of Canada is awesome and spectacular. This course prepares the students for the trip in terms of logistics and overviews of the geology of each location that will be visited. Students may retake class for different locations.
Credits: 1.0; May be repeated
Lec-Rec-Lab: (1-0-0)
Semesters Offered: Spring

GE 4919 - Field Geology in East Africa
Introduction to field geology of East Africa. Intended for students with an interest in geological sciences. Requires paper(s) and digital scrapbook.
Credits: 4.0
Lec-Rec-Lab: (0-0-12)
Semesters Offered: Summer
Restrictions: Permission of instructor required

GE 4919 - Geology and Field Excursion to Canada
The geology of Canada is visited on this 28 day field excursion via van and camping. Canada’s geology offers spectacular study opportunities and provides a true field based experience. Students may retake class for different locations.
Credits: 3.0; Repeatable to a Max of 9
Lec-Rec-Lab: (0-0-9)
Semesters Offered: Summer
Restrictions: Permission of instructor required
Pre-Requisite(s): GE 4918

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GE 4920 - Geological Engineering Seminar
Seminar course dealing with geological engineering subjects of current interest.
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, Sophomore

GE 4921 - Geology Seminar
Seminar course dealing with geology subjects of current interest.
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, Sophomore

GE 4922 - Geophysics Seminar
Seminar course dealing with geophysics subjects of current interest.
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, Sophomore

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-Requisite(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
Restrictions: Permission of instructor required

GE 4960 - Independent Geological Engineering Research Project
Approved engineering design research project 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 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 5001 - Intercultural Natural Hazards Communication in Latin America
Credits: 2.0
Lec-Rec-Lab: (0-2-0)
Semesters Offered: Fall
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

GE 5020 - Earth Systems Science I
Includes basic geologic content traditionally covered in university-level physical geology and historical geology. The course contact is a stepping through geologic time from the present in to the past. The course will take a place-based approach, using the geologic record of Michigan.
Credits: 4.0
Lec-Rec-Lab: (0-4-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Level(s): Graduate

GE 5030 - Earth Systems Science II
Focuses on material traditionally covered in courses on astronomy, meteorology, and oceanography. This course will also address content from the field by focusing on the Earth’s climate system.
Credits: 4.0
Lec-Rec-Lab: (0-4-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate

GE 5040 - Evolution of Structures in Deformed Rock
How rocks deform on microstructural, outcrop, and regional scales. Topics include plasticity and annealing, fabrics, foliation development, thrust faulting and duplex development, style group analysis of folds, advanced mapping techniques in metamorphic rocks and strain analysis.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

GE 5100 - Advanced Geomorphology and Glacial Geology
In-depth study of surficial processes that shape landforms and determine the composition and character of the Earth’s surface. Processes studied include glacial, fluvial, wind, mass movement, and wave action. Emphasizes the role of past and present climate. In-depth report and presentation on two separate topics required.
Credits: 4.0
Lec-Rec-Lab: (3-0-3)
Semesters Offered: Fall - Offered alternate years beginning with the 2003-2004 academic year.
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): GE 2000

GE 5130 - Geology of the National Parks: Field Experience
A two-week, field-based course taught in National Parks Course requires a project and special assignments. Lab fee costs dependent upon location.
Credits: 4.0
Lec-Rec-Lab: (0-4-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

GE 5140 - Paleoclimatology
This course will investigate the geologic evidence of global climate and the mechanisms that are interpreted to produce climate change.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: On Demand

GE 5150 - Advanced Natural Hazards
Exploration of how to develop comprehensive plans to mitigate the impact of natural hazards on humans. Requires a project and report.
Credits: 3.0
Lec-Rec-Lab: (2-0-3)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

GE 5155 - Natural Hazards and Human Impacts
The interaction of humans and environment is examined through field study on the Keweenaw Peninsula. Focus on natural hazards, geological and geographical landscapes and processes. Integrates scientific and social scientific content knowledge with pedagogical approaches for K-12 teachers.
Credits: 3.0
Lec-Rec-Lab: (0-1-6)
Semesters Offered: Summer
Restrictions: Permission of department required. May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

GE 5180 - Volcanology
Volcanoes and how they work. Volcanic products, their recognition, and significance. Applies chemistry, physics, and fluid mechanics in a volcanological context.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate
GE 5185 - Special Topics in Volcanology  
A special offering class devoted to an advanced topic in volcanology of topical interest, such as Megaeruptions, Convergent Plate Boundary volcanism or Volcanic Landslides. The class will be built around lectures from 6 different universities, linked via videoconferencing.  
Credits: 2.0; May be repeated  
Lec-Rec-Lab: (1-1-0)  
Semesters Offered: On Demand - Offered alternate years beginning with the 2005-2006 academic year  
Restrictions: Must be enrolled in one of the following Major(s): Geology, Geophysics, Geological Engineering; May not be enrolled in one of the following Class(es): Freshman, Sophomore

GE 5187 - Volcanological Field Seminar  
Field Seminars of 1-3 weeks to volcanological sites of interest. These are offered in association and following GE5185. The field seminars are complemented by the preceding semester's classes, which examine the broad context of the field events. The two classes may be taken together as 4 credits or separately.  
Credits: 2.0; May be repeated  
Lec-Rec-Lab: (0-0-6)  
Semesters Offered: On Demand  
Restrictions: Must be enrolled in one of the following Major(s): Geology, Geophysics, Geological Engineering; May not be enrolled in one of the following Class(es): Freshman, Sophomore

GE 5195 - Volcano Seismology  
Will prepare students, including those with no seismology background, to interpret seismic and acoustic signals from volcanoes. Topics: basic seismology, monitoring techniques, tectonic and volcanic earthquakes, infrasound, deformation over a range of time scales.  
Credits: 3.0  
Lec-Rec-Lab: (2-0-1)  
Semesters Offered: Spring  
Pre-Requisite(s): (MA 1160 or MA 1161 or MA 1135) and GE 2000 and PH 2100

GE 5230 - Earth Systems Institute I  
A professional development course for K-12 teachers that uses the scientific method in earth system science to make observations, develop hypotheses, collect data, test hypotheses, and communicate results. A field-based course conducted primarily on the Keweenaw Peninsula.  
Credits: 4.0  
Lec-Rec-Lab: (0-4-0)  
Semesters Offered: Summer  
Restrictions: Permission of department required; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

GE 5240 - Earth Systems Institute II  
This teacher professional development course will address science content, pedagogy, and professional effectiveness to ensure that teachers' pedagogy allows them to connect to the experiences of all students. Topics will include visualization tools, earth system science data sources, inquiry-based instruction, teaching for understanding, and strategies for engaging diverse and special needs learners.  
Credits: 4.0  
Lec-Rec-Lab: (0-4-0)  
Semesters Offered: Summer  
Restrictions: Permission of department required; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

GE 5250 - Advanced Computational Geosciences  
Introduction to quantitative analysis and display of geologic data using Matlab and Excel, covering basic Matlab syntax and programming, and analysis of one-dimensional (e.g. time series) and two-dimensional datasets (e.g. spatial data). Techniques are applied to geological datasets.  
Credits: 3.0  
Lec-Rec-Lab: (2-0-1)  
Semesters Offered: Spring  
Restrictions: Must be enrolled in one of the following Level(s): Graduate

GE 5270 - Volcanic Clouds  
Synthesis of recent advancements in volcanic cloud research along with theoretical background and practical experience in the study, understanding and remote sensing of volcanic clouds. Techniques covered are also applicable to other atmospheric phenomena although volcanic ash, gas and aerosol remote sensing is the main focus.  
Credits: 4.0; Repeatable to a Max of 8  
Lec-Rec-Lab: (2-0-6)  
Semesters Offered: On Demand  
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

GE 5400 - Global Geophysics and Geotectonics  
Plate tectonics and the internal structure of the earth using information from seismology, geomagnetism gravity, and heat flow. A term project/report is required.  
Credits: 3.0  
Lec-Rec-Lab: (0-3-0)  
Semesters Offered: On Demand  
Restrictions: Must be enrolled in one of the following Level(s): Graduate  
Pre-Requisite(s): MA 3160 and PH 2200 and GE 2000

GE 5405 - Geophysics for Archaeology  
Principles and practice of non-invasive archaeogeophysics (remote sensing) such as magnetometry, ground penetrating radar and resistivity. Data interpretation will involve basic computation, contouring, three-dimensional visualization programs, interpretation and archaeological significance. Activities include fieldwork, data analysis and presentation, and short reports. The mathematical content of the class will be minimal.  
Credits: 3.0  
Lec-Rec-Lab: (2-0-1)  
Semesters Offered: Fall - Offered alternate years beginning with the 2003-2004 academic year

GE 5450 - Potential Field Theory in Gravity and Magnetic Applications  
The fundamentals of potential theory and the application to gravity and magnetic studies of the crust and lithosphere. Topics include Newtonian & magnetic potential, magnetization, regional gravity fields, the geomagnetic field, forward & inverse modeling, Fourier-domain modeling and transformations.  
Credits: 3.0

GE 5500 - Paleomagnetism and Environmental Magnetism  
Origin and interpretation of the natural remanent magnetism in rocks and its use in deciphering the geologic past. Applications studied are plate tectonic movements, environmental change, stratigraphic correlation, and the earth's magnetic field.  
Credits: 3.0  
Lec-Rec-Lab: (3-0-0)  
Semesters Offered: On Demand  
Restrictions: Must be enrolled in one of the following Level(s): Graduate  
Pre-Requisite(s): GE 2000

GE 5600 - Advanced Reflection Seismology  
Principles and application of reflection seismic techniques. Includes acquisition, data processing, and 2D/3D data interpretation. Project and report required.  
Credits: 3.0  
Lec-Rec-Lab: (2-1-0)  
Semesters Offered: On Demand  
Restrictions: Must be enrolled in one of the following Level(s): Graduate

GE 5610 - Quantitative Reservoir Characterization  
Develop and integrate several aspects of reservoir characterization using data from actual oil and gas fields. The various aspects include well log, seismic data, production data, and geologic/outcrop inference. Geostatistical routines and integrated software suites.  
Credits: 3.0  
Lec-Rec-Lab: (1-2-0)  
Semesters Offered: On Demand  
Restrictions: Must be enrolled in one of the following Level(s): Graduate

GE 5650 - Special Topics in Petroleum Geology  
The study of current topics in petroleum geology. Research papers and reports are required.  
Credits: variable to 4.0; Repeatable to a Max of 8  
Semesters Offered: Spring  
Restrictions: Must be enrolled in one of the following Level(s): Graduate

GE 5785 - Seismic Petrophysics  
Seismic petrophysics describes the use of rock physics information and logging data in the interpretation of reflection seismic data. The theories and empirical models relating seismic properties to other properties of rocks will be reviewed, and the logging techniques responsible for identifying those properties discussed. Various approaches to the quantitative interpretation of seismic data are covered. For varying course credit, projects with real data will be conducted by students.  
Credits: variable to 3.0  
Semesters Offered: On Demand  
Restrictions: Must be enrolled in one of the following Level(s): Graduate

GE 5800 - Mathematical Modeling of Earth Systems  
Introduction to numerical techniques for mathematical modeling of various earth-system phenomena, including groundwater flow, heat transfer, and atmospheric transport. Numerical techniques covered include finite-difference, finite-element, collocation, and characteristic methods. Students write their own mathematical models. Prerequisite: experience in programming computer languages such as FORTRAN.  
Credits: 3.0  
Lec-Rec-Lab: (3-0-0)  
Semesters Offered: On Demand  
Restrictions: Must be enrolled in one of the following Level(s): Graduate

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GE 5810 - Flow and Transport in Subsurface Systems
Analysis of fluid flow in geologic materials, including groundwater flow, solute and contaminant transport, heat flow, and petroleum movement. Develops fundamental transport equations and numerical methods for solving these equations.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

GE 5850 - Advanced Groundwater Engineering and Remediation
Computer modeling and other advanced topics in the analysis hydrological systems, contaminant transport and fate, and subsurface remediation systems.
Credits: 3.0
Lec-Rec-Lab: (0-2-3)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Class(es): Graduate

GE 5910 - Geology Seminar
Seminar course dealing with geology subjects of current interest.
Credits: 3.0; Repeatable to a Max of 9
Lec-Rec-Lab: (3-0-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

GE 5920 - Geophysics Seminar
Seminar course dealing with geophysics subjects of current interest.
Credits: 3.0; Repeatable to a Max of 9
Lec-Rec-Lab: (3-0-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

GE 5930 - Special Topics in Geological Engineering
Study and discussion of geological engineering topics.
Credits: variable to 9.0; Repeatable to a Max of 9
Semesters Offered: On Demand
Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

GE 5940 - Special Topics in Geology
Study and discussion of geology topics.
Credits: variable to 9.0; Repeatable to a Max of 9
Semesters Offered: On Demand
Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

GE 5941 - Special Topics in Mineralogy
The study of special topics in mineralogy using the Seaman Mineral Museum.
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 Level(s): Graduate

GE 5950 - Special Topics in Geophysics
Study and discussion of geophysics topics.
Credits: variable to 9.0; Repeatable to a Max of 9
Semesters Offered: On Demand
Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

GE 5960 - Special Topics in Mining Engineering
Study and discussion of mining engineering topics.
Credits: variable to 9.0; Repeatable to a Max of 9
Semesters Offered: On Demand
Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

GE 5975 - Full Time Master's Research
Open to students who have successfully completed all the required courses as well as the required number of credits for the master's degree. Students in this course are involved in full-time research. Tuition for this course is charged at the graduate full-time research rate. Students enrolled in this course may not register for any other course.
Credits: 9.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-9-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

GE 5994 - International Geological Practicum
Geological field work outside of the U.S. used by Peace Corps Master International students during their field assignments. May be used repeatedly up to 12 credits.
Credits: 1.0; Repeatable to a Max of 12
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Major(s): Geology, Geophysics, Geological Engineering

GE 5998 - International Geology Master's Research
An original investigation in theoretical or experimental natural geological hazard mitigation and submission of a thesis or report in partial fulfillment of the MS degree conducted while in the Peace Corps Program.
Credits: variable to 9.0; Graded Pass/Fail Only
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following College(s): College of Engineering

GE 5999 - Master's Graduate Research
Research of an acceptable geological engineering, mining engineering, geology, or geophysics problem and preparation of a thesis.
Credits: variable to 15.0; May be repeated; Graded Pass/Fail Only
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate

GE 6975 - Full-Time Doctoral Research
Open to students who have successfully completed all required courses as well as the comprehensive and proposal defense exams. Students in this course are involved in full-time research. Tuition for this course is charged at the graduate full-time research rate. Students enrolled in this course may not register for any other course.
Credits: 9.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-9-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

GE 6999 - Doctoral Graduate Research
Original research of an acceptable geological engineering, mining engineering, geology, or geophysics problem and preparation of a PhD dissertation.
Credits: variable to 15.0; May be repeated; Graded Pass/Fail Only
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate

Humanities

HU 0110 - Development of Academic Literacy Skills
Scheduled weekly appointments with a writing coach to improve writing and reading effectiveness in any course except Perspectives, World Cultures, or Revisions. (For coaching in these courses, see HU0121, 0122, 0123). Specialized assistance available to students who speak English as a Second Language and students who have learning disabilities. Credits do not count toward graduation.
Credits: 0.0; May be repeated; Graded Pass/Fail Only
Semesters Offered: Fall, Spring, Summer

HU 0121 - Perspectives Coaching
Scheduled weekly appointment with a writing coach to improve writing, speaking, and reading effectiveness in Perspectives (UN1001). Strongly recommended for students with English ACT of 20 or below. Credits do not count toward graduation.
Credits: 0.0; May be repeated; Graded Pass/Fail Only
Semesters Offered: Fall, Spring, Summer

HU 0122 - World Cultures Study Team
Students who are enrolled in World Cultures (UN1002) may sign up for a study team led by a writing center coach. Teams meet twice weekly. The meetings address the challenges of the World Cultures 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
Co-Requisite(s): UN 1002

HU 0123 - Revisions Coaching
Scheduled weekly appointment with a writing coach to improve writing and reading effectiveness in Revisions (UN2001). Strongly recommended for students with English ACT of 20 or below. Credits do not count toward graduation.
Credits: 0.0; May be repeated; Graded Pass/Fail Only
Semesters Offered: Fall, Spring
Co-Requisite(s): UN 2001

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; Graded Pass/Fail Only
Semesters Offered: Fall, Spring
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 HU 0125 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; Graded Pass/Fail Only
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate

HU 2110 - Creative Writing
Writing practice in one or more of the major creative genres, including poetry, short fiction, and literary nonfiction. Combines creative theory with process-oriented writing exercises. Stresses a workshop approach and requires a portfolio of creative work at term's end.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring, Summer

HU 2130 - Introduction to Rhetoric
Examines the classical origins, cultural contexts, and contemporary relevance of rhetorical traditions.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Summer

HU 2241 - Level I-A Less Commonly Taught Languages
Introduction to basic vocabulary, grammar, 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: Fall, Summer

HU 2242 - Level I-B Less Commonly Taught Languages
Further study of vocabulary, grammar, 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: Fall, Spring, Summer

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, Summer

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, Summer

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 credit.
Credits: 3.0
Lec-Rec-Lab: (0-2-3)
Semesters Offered: Fall, Spring, Summer

HU 2281 - Level I-A German Language and Culture
Introduction to 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, Summer
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, Summer

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, Summer
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, Summer
Pre-Requisite(s): HU 2291 or Language Placement Spanish I >= 201

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, Summer

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, Summer

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

HU 2501 - The American Experience in Literature I
A survey of writings and the oral tradition from the earliest explorers, Native Americans, and African-Americans to about 1850. Readings in such genres as histories, diaries, sermons, poetry, and short stories. Several films may be viewed.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2003-2004 academic year

HU 2502 - The American Experience in Literature II
A historical survey of American Literature from about 1850 to the present, focusing on such themes as nature, the individual, democracy, race, optimism, and science. Discussions may be supplemented with films
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2003-2004 academic year

HU 2505 - Science, Technology, and Humanities I
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 to the eighteenth century.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2000-2001 academic year

HU 2506 - Science, Technology, and Humanities II
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 nineteenth and twentieth centuries.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring, Summer - Offered alternate years beginning with the 2001-2002 academic year
HU 2520 - Cultural Diversity in American Literature
Study of literature by authors from historically under-represented groups within the United States. May be supplemented by literature from South and Central America and the Caribbean and by films and essays on approaches to difference.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring, Summer

HU 2538 - British Experience in Literature I
A survey of major works of British literature from Beowulf to the Restoration. Focuses on the states of the developing English language. Texts may be supplemented with films.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2002-2003 academic year

HU 2539 - British Experience in Literature II
A survey of major works of British authors of the nineteenth and twentieth centuries. Works may be illustrated through films and other visual media.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2002-2003 academic year

HU 2547 - World Drama
Study of the forms of dramatic literature from around the world with particular attention to thematic and dramatic development. Emphasizes performance as well as literary aspects of plays. Film versions may also be viewed.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2001-2002 academic year

HU 2548 - Adolescent 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, Summer

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, Spring
Restrictions: Must be enrolled in one of the following Major(s): Scientific & Tech Comm (BS), Scientific & Tech Comm (BA)

HU 2631 - Fundamentals of Darkroom Photography
Students will explore the history, theory and applications of traditional black and white photography through readings, lecture, student presentations, and hands-on camera and darkroom work. Students will learn in-depth camera techniques and darkroom processes while also having an opportunity to explore related areas such as digital photography, color slide photography, and other photographic processes through special projects.
Credits: 3.0
Lec-Rec-Lab: (0-2-3)
Semesters Offered: On Demand

HU 2632 - 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: Fall, Spring, Summer

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, Summer

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, Summer

HU 2650 - Introduction to Web-Design
Provides experience in planning and constructing web pages. Discusses historical, ethical, and social implications of the Internet and digital culture. Students will develop a balance of technical and aesthetic knowledge and an understanding of some of the problems and limitations of the Internet and the World Wide Web.
Credits: 3.0
Lec-Rec-Lab: (0-2-3)
Semesters Offered: Spring, Summer

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, Summer

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: Fall, Spring

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 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, Summer

HU 2830 - Introduction to Speech Communication
Introduces the diversity of perspectives in speech communication with emphasis on public speaking. Topics include the nature of the public sphere, co-cultural contexts, speaking anxiety, conventional and non-Western models of structure and evidence, and speaking/listening competencies.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring, Summer

HU 2910 - Language and Mind
Linguistic study of structural and cognitive aspects of language. Examines language design: how sounds, words, sentences, and conversation create meaning; the relationship of language, brain, mind, and thought; the ability of humans, animals, and machines to acquire language.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Summer

HU 2920 - Language and Society
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: Spring, Summer

HU 3120 - Technical and Scientific 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 1002 or UN 1003

HU 3130 - Rhetorical Theory and Criticism
A study of contemporary theories of rhetoric and their application to understanding and critiquing various forms of persuasive discourse.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): UN 1002 or UN 1003
HU 3150 - Reading and Writing
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 and to various textual media.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): (UN 1002 or UN 1003) and UN 2001

HU 3151 - The Rhetoric of Everyday Texts
The examination and production of everyday texts such as image-texts, e-mail, web pages, signs, museum exhibits, architecture, and fashion in terms of their theoretical, historical, cultural, and technological contexts. Students 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 1002 or UN 1003

HU 3251 - Great Works of World Literature
Study of world literature in translation. May be taught in comparative perspective.
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 Pre-Requisite(s): UN 1002 or UN 1003

HU 3252 - Literature in Translation
Study of non-canonical literature in English translation of Western and non-Western authors.
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 Pre-Requisite(s): UN 1002 or UN 1003

HU 3253 - Topics in World Literatures and Cultures
Comparative approach to selected fictional works and essays in English translation of Western and non-Western authors.
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): UN 1002 or UN 1003

HU 3261 - Communicating Across Cultures
Comparative study of communication styles across selected cultures with emphasis on cultural patterns, attitudes, values, and nonverbal behaviors. Readings for discussion selected from interdisciplinary texts and discourses may include intercultural communication theory, ethnography, literature, linguistics, and philosophy.
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): UN 1002 or UN 1003

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: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Freshman Pre-Requisite(s): UN 1002 or UN 1003

HU 3263 - Topics in German-Speaking Cultures
An introduction to German-speaking culture (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: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Freshman Pre-Requisite(s): UN 1002 or UN 1003

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: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Freshman Pre-Requisite(s): UN 1002 or UN 1003

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
Pre-Requisite(s): HU 2272 or HU 2273 or Language Placement French II >= 301

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: Spring
Pre-Requisite(s): HU 3271 or Language Placement French II >= 301

HU 3273 - Level II French Composition and Conversation
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.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): HU 2272 or HU 2273 or Language Placement French II >= 301

HU 3274 - Level III Topics in French Literature and Culture
A survey of French literature or of various aspects of modern French society, emphasizing historical and cultural backgrounds. Conducted primarily in French.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Pre-Requisite(s): HU 3272 or HU 3273 or Language Placement French III >= 401

HU 3275 - Level III French for Special Purposes
Study of business, technical, and/or scientific discourses in the context of French language and Francophone cultures.
Credits: 3.0; Repeatable to a Max of 6
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Pre-Requisite(s): HU 3272 or HU 3273 or Language Placement French III >= 401

HU 3281 - Level II-A German Language and Culture
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.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): HU 2282 or Language Placement German II >= 341

HU 3282 - Level II-B German Language and Culture
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, readings of literary texts, screenings of German films, and writing of compositions in German.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): HU 3281 or Language Placement German II >= 341

HU 3283 - Level II German for Special Purposes
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.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): HU 2282 or Language Placement German II >= 341
HU 3284 - Level III in German Literature and Culture
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.
Credits: 3.0; Repeatable to a Max of 6
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): HU 3281 and (HU 3282 or HU 3283) or Language Placement German III >= 441

HU 3285 - Level III German: Film and Media
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.
Credits: 3.0; Repeatable to a Max of 6
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): HU 3281 and (HU 3282 or HU 3283) or Language Placement German III >= 441

HU 3291 - Level II Spanish Language and Culture
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.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): HU 2292 or HU 2293 or Language Placement Spanish II >= 341

HU 3292 - Level II-B Spanish Language and Culture
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.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): HU 2293 or HU 3291 or Language Placement Spanish II >= 341

HU 3293 - Level II Spanish for Special Purposes
Intermediate to advanced intermediate readings, discussion, and writing on selected topics as posed by technical, scientific, engineering or business discourses in the context of Hispanic cultures. Students completing this course may apply for placement credit.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): HU 2293 or HU 3291 or HU 3292 or Language Placement Spanish II >= 341

HU 3294 - Level III Topics in Spanish Literature and Culture
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 credit.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): HU 3291 and (HU 3292 or HU 3293) or Language Placement Spanish III >= 441

HU 3295 - Level III Spanish for Specific Literacies
Study of specific discourses in Spanish. May include readings and discussion topics in intercultural communication, rhetoric, philosophy, literature, environmental studies, and/or social studies. Emphasis on the understanding of key issues across disciplines and cultures. Stresses reading, writing, and oral presentations. Students completing this course may apply for placement credit.
Credits: 3.0; Repeatable to a Max of 6
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): HU 3291 and (HU 3292 or HU 3293) or Language Placement Spanish III >= 441

HU 3296 - Visual Media Analysis
Introduction to selected topics in contemporary visual media. Topics may include genre studies, national cinema, independent film and video, auteur approaches, and other contemporary issues. Students are expected to examine critically the theoretical, industrial, cultural, and aesthetic challenges posed by particular visual media and the contexts from which they emerge.
Credits: 3.0
Lec-Rec-Lab: (0-2-3)
Semesters Offered: Spring
Restrictions: Permission of instructor required; May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): UN 1002 or UN 1003

HU 3324 - Topics in Diversity Studies
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

HU 3351 - Medieval Literature
Study of such topics as King Arthur, mystery plays, the epic, and Dante's Divine Comedy as part of the literature of the Middle Ages. Films may supplement literary texts. Selected topics are offered every other year by individual instructors.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2000-2001 academic year
Pre-Requisite(s): UN 1002 or UN 1003

HU 3502 - World Mythologies
Survey of the major mythological systems of the world with particular attention to those areas of commonality between the 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 1002 or UN 1003

HU 3504 - Novels from World Literature
Comparative approach to selected novels of Western and non-Western authors, excluding English and North American, and including works by non-European writers. Film versions of selected novels may also be studied.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2000-2001 academic year
Pre-Requisite(s): UN 1002 or UN 1003

HU 3510 - The American Novel
Examination of the novel in America with special attention to the historical, sociological, and personal contexts within which the author is writing. Film versions of selected novels may also be studied.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): HU 3291 or UN 1002 or UN 1003

HU 3512 - Shakespeare I
Study of selected plays by Shakespeare including comedies, histories, and tragedies. Film versions of several plays may also be examined.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): UN 1002 or UN 1003

HU 3513 - Shakespeare II
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: Spring
Pre-Requisite(s): UN 1002 or UN 1003

HU 3517 - British and American Literary Studies
A consideration of a variety of critical approaches to Literature and methods of Literary research in the context of Literary texts by British and American authors and possibly of film versions of the texts.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2004-2005 academic year

HU 3540 - Major British Authors
Reading in depth from the works of one or more of the major British writers, excluding Shakespeare. May include examination of non-print media such as film.
Credits: 3.0; Repeatable to a Max of 6
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): UN 1002 or UN 1003

HU 3541 - Major American Authors
Reading in depth from the works of one or more major American writers. May include examination of supplementary material such as films.
Credits: 3.0; Repeatable to a Max of 6
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): UN 1002 or UN 1003
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

HU 3551 - Renaissance English Literature
Study of important figures and genres in English literature from the sixteenth through the seventeenth century. Selected films may also be viewed and analyzed.
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): UN 1002 or UN 1003

HU 3552 - Restoration and 18th Century English Literature
Study of important figures and genres in English literature from the late-seventeenth century through the eighteenth century. Selected films may also be viewed and analyzed.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall or UN 1003

Hu 3553 - British Romantic and Victorian Literature
Readings of selected figures and works from nineteenth-century British literature. Genres include poetry, prose, and novels. Major topics include nature, transcendentalism, imagination, the growth of science and its impact on religious faith, and the fate of humanistic culture in a technological age. Background material may include selected films.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall or UN 1003

HU 3554 - British Authors of Fiction and Fantasy
Close study of the work of one or more major British authors of the twentieth and twentieth-first centuries with attention to the writer's style, methods, and genre usage. Will regularly focus on authors of historical fiction and fantasy. Selected films may help establish literary context.
Credits: 3.0; Repeatable to a Max of 6
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): UN 1002 or UN 1003

HU 3555 - British Literature
Study of British, British colonial, and independence literature of the twentieth and twenty-first centuries. Will explore relationships between literature and other areas such as the arts, film, architecture, history, and philosophy.
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 1002 or UN 1003

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): Scientific & Tech Comm (BS), Liberal Arts, Scientific & Tech Comm (BA), Humanities, Comm and Culture Studies; May not be enrolled in one of the following Class(es): Freshman, Sophomore

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: Fall
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): UN 1002 or UN 1003

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: Spring
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, Summer
Pre-Requisite(s): UN 2001 and (UN 1002 or UN 1003)

HU 3629 - Special Topics in Professional Writing
Focuses on professional and workplace writing in selected genres such as reports, proposals, or grants. Teaches students to use rhetorical analysis to be more effective writers in a range of subjects. With different topics, may be taken twice for credit.
Credits: 3.0; Repeatable to a Max of 6
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): UN 1002 or UN 1003

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

HU 3642 - Multimedia
A hands-on and theoretical introduction to multimedia development. Students construct a prototype multimedia project. They plan a project; construct a project team; design an effective interface integrating color, sound, and graphics; and test. Students analyze multimedia projects and writings about multimedia.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): HU 2642

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 2002

HU 3701 - Philosophy of Technology
A study of philosophical aspects of technology. Topics may include technology and progress; technology and ideology; technology and nature; technological determinism; ethics and technology; technology as a world view; gender, race, class, and technology; and the relationship between technology and dystopias, utopias, and the "good life."
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): UN 2002

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 1002 or UN 1003

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 1002 or UN 1003

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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 1002 or UN 1003

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, Summer
Pre-Requisite(s): UN 1002 or UN 1003

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 1002 or UN 1003

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: Spring
Pre-Requisite(s): UN 1002 or UN 1003

HU 3860 - Popular Culture
Explores specific examples of popular culture that reveal how popular values, feelings, and beliefs are created and maintained. Considers the historical, social, political, and economic contexts of popular culture from a communication perspective.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring, Summer
Pre-Requisite(s): UN 1002 or UN 1003

HU 3871 - Media and Communication 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: Fall
Pre-Requisite(s): UN 1002 or UN 1003

HU 3881 - Communication and History
Examines the development of communication in relation to the changing contexts of culture and technology. Includes consideration of pre-literate, oral cultures, the development of alphabetization; scribal cultures, the printing press, electronic and mass media.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): UN 1002 or UN 1003

HU 3890 - Documentary
Considers technical, theoretical, aesthetic and ethical dimensions of documentary media through analysis and production.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring, Summer
Pre-Requisite(s): UN 1002 or UN 1003

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, Summer - Offered alternate years beginning with the 2009-2010 academic year
Pre-Requisite(s): UN 1002 or UN 1003

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

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 4071 - Liberal Arts Capstone Project
A one-semester research project which demonstrates the skills in and knowledge of one or more disciplines covered by the major. Work is carried out under the supervision of a faculty advisor and results in a project that includes a writing component of substantial length.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Major(s): Liberal Arts; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

HU 4101 - Writing Center Practicum
Reflective practicum in which theories of learning, literacy, and cultural differences are applied in the writing 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 1001 and (UN 1002 or UN 1003) and UN 2001(C)

HU 4110 - Advanced Creative Writing
Intensive practice in one of the major creative genres, including poetry, short fiction, and literary nonfiction. The class combines workshops with small group work and individual conferences with the goal or producing several pieces of creative work published to publication standards.
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): HU 2110 and UN 2001(C)

HU 4130 - Special Topics in Rhetoric or Composition
An in-depth examination of selected problems, issues, periods, theorists, or concepts in rhetoric (such as rhetoric and the environment, feminist rhetoric, the rhetoric of science, classical rhetoric, the Sophists, argumentation theory) or composition studies (such as literacy practices in social contexts, voice, composing processes, world Englishes, computers and writing).
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)

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
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 - 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: Fall, Spring
Pre-Requisite(s): HU 3284 or HU 3285

HU 4281 - Modern Language Seminar I-German
Language and power. Critical study of the representation of politics, economies, 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 2008-2009.
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 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 2008-2009.
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 relationship between modern technology and 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 2008-2009.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): HU 3284 or HU 3285

HU 4291 - Level IV Modern Language Seminar I-Spanish
Language and power. Critical study of the representation of politics, economies, and social institutions in literature, film, and authentic texts in French, German, and Hispanic language communities. Students read texts in Spanish and in English translation.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Pre-Requisite(s): HU 3294 or HU 3295

HU 4292 - Level IV Modern Language Seminar II-Spanish
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 speaking communities. Students read texts in Spanish and in English translation.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Pre-Requisite(s): HU 3294 or HU 3295

HU 4293 - Level IV Modern Language Seminar III-Spanish
Technology in literature and film. Critical study of the relationship between modern technology and literature, film, and authentic documents from French, German, and Hispanic language communities. Students read texts in Spanish and in English translation.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Pre-Requisite(s): HU 3294 or HU 3295

HU 4542 - Topics in American Literature
Selected problems posed by literary genres, themes, movements, and individual authors in American literature.
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
Pre-Requisite(s): UN 1002 or UN 1003

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, Summer
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): UN 2002

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

HU 4630 - Teaching with Technology Across the Curriculum
Designed to explore use of technology-rich environments in improvement of teaching and learning and how such environments should be designed, implemented, and assessed. Includes introduction to internet, video and audio, presentional, and online assessment/portfolio technologies.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Fall

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, Spring
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 - Special Topics in Advanced Media Development
Critical and practical topics in the quickly changing media of our time. Topics may include digital photography, advanced multimedia development, advanced graphic design, color theory, or three-dimensional modeling and rendering.
Credits: 3.0
Lec-Rec-Lab: (0-2-3)
Semesters Offered: On Demand
Restrictions: Permission of instructor required
Pre-Requisite(s): UN 1002 or UN 1003

HU 4690 - Special Topics in Technical Communication
In-depth examination of selected topics in scientific and technical communication.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2000-2001 academic year
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: Spring
Pre-Requisite(s): UN 1002 or UN 1003

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: On Demand
Pre-Requisite(s): UN 1002 or UN 1003

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
Pre-Requisite(s): UN 1002 or UN 1003

HU 5001 - Proseminar in Rhetoric and Technical Communication
An introduction to the issues, goals, and scholarly methods across the disciplinary areas represented in the Rhetoric and Technical Communication Program.
Credits: 1.0; Repeatable to a Max of 5
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Rhetoric & Tech Communication

HU 5002 - Rhetoric, Composition and Literacy Studies
This course considers key theoretical, pedagogical, and historical issues and events that have linked the fields of rhetoric, composition, and literary studies.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Rhetoric & Tech Communication

HU 5003 - Technical Communication and Technology Studies
This course considers key historical, pedagogical, and theoretical issues in technical communication, scientific communication, and technology studies. Considerable attention is paid to the practice and critique of technical communication and technology in academic and non-academic settings.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Rhetoric & Tech Communication

HU 5004 - Communication in Cultural Contexts
This course considers key issues in how cultural contexts and processes of communication affect representation, understanding, and practice.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Rhetoric & Tech Communication

HU 5005 - Knowledge and Inquiry in the Humanities
This course considers a range of methods, methodologies, and approaches to research that inform scholarship in RTC program. Approaches may include qualitative, ethnographic, quantitative, rhetorical, feminist, historiographic, hermeneutic, literary, and interpretive methods.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Rhetoric & Tech Communication

HU 5010 - Organizational Communication
Theoretical review of the role of communication in organizations. Emphasizes critical interpretive approaches.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate
HU 5080 - Computer Applications in Technical Communication
An examination of how industry and educational institutions employ computers to create, design, and distribute information. Emphasizes such topics as interactive computer-assisted instruction, computerized telecommunications, word processing, document design, and graphics.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

HU 5081 - Writing Applications in Technical Communication
A writing-intensive course focusing on special writing assignments for professional technical communicators, such as company annual report narratives and internal magazine articles, especially articles focusing on scientific and technical research.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

HU 5090 - Writing Literary Nonfiction
Writing and editing nonfiction for publication in Blue Ice Anthology, a general interest journal published in the Department of Humanities. Course includes study of theory and techniques of literary nonfiction.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

HU 5091 - Writing for Publication
Practice in writing to the requirements of professional publications and in identifying the rhetorical considerations of writing for different publications.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

HU 5092 - Grammar and Editing for Professionals
An examination of the text-based decisions professional editors make as they prepare manuscripts for publication. Through practice on real documents, students obtain strategies for text editing, acquire a professional vocabulary for communicating effectively with authors, and sharpen their grammar and proofreading skills.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

HU 5100 - Qualitative Humanistic Research
Course addresses qualitative or quantitative methods. Field methods in the humanities include the three foundations of qualitative methods; participant observation, interviews, and cultural text analysis. Quantitative methods of inquiry include philosophical foundations of empirical research, structure of quantitative inquiry, modes of observation, and data analysis. Students conduct preliminary research projects.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

HU 5101 - Writing for Publication
Practice in writing to the requirements of professional publications and in identifying the rhetorical considerations of writing for different publications.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

HU 5112 - Critical Perspectives on Science and Technology
Philosophical, rhetorical, literary, or cultural studies perspectives on science and technology. Topics may include philosophy of science, philosophy of technology, rhetoric of science, rhetoric of technology, etc.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

HU 5113 - Cultural Studies
Introduction to the theoretical history, methods, and practice of cultural studies. Includes the influence of literary humanism, Marxism, structuralism, subcultural studies, feminism, postmodernism, articulation theory, Deleuze and Guattari.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

HU 5114 - Introduction to Visual Representation
A critical survey of selected theoretical, philosophical, and methodological issues that inform various disciplinary perspectives on the study of the visual, such as sociology, film and television theory, communication, and art history.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

HU 5115 - Literacy, Technology, Society and Education
Examines the linkage between technology and literacy in the U.S. and the ways in which this linkage has been established in public schools, workplace programs, or university settings.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

HU 5116 - Rhetorics of Difference/Alterity
A critical examination of discourses, theories, and representations of otherness or difference according to race, gender, sexuality, class, age, nationality, ethnic background, and other socio-cultural categories. May include discussion of issues of self-representation within and among groups, the rhetorics of exile or diaspora, colonial and postcolonial constructions of identity.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

HU 5117 - Theories of Language
Study of major theories of language that have influenced contemporary work on discourse, language, and literacy. Focuses on language theorists from one or more of a variety of disciplines, such as philosophy, linguistics, literary studies, psychology, anthropology, and rhetoric.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

HU 5118 - Theories of Pedagogy
Contemporary theories of pedagogy that influence current approaches to teaching writing, including feminist pedagogy, critical pedagogy, liberatory pedagogy, and psychological and developmental approaches to pedagogy.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

HU 5119 - Directed Reading
Directed reading in a focused area under the direction of a member of the graduate faculty. Open to advanced master's students in RTC only. Students must meet with their supervising instructor and receive approval of their study plan from the Director of RTC before registering.
Credits: variable to 6.0; Repeatable to a Max of 6
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Rhetoric & Tech Communication

HU 5190 - Independent Study
Guided research under the direction of a member of the graduate faculty. Open to advanced master's students in RTC only. Students must meet with their supervising instructor and receive approval of their study plan from the Director of RTC before registering.
Credits: variable to 6.0; Repeatable to a Max of 6
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Rhetoric & Tech Communication

HU 5902 - Internship
Work experience under the direction of a member of the graduate faculty, for advanced MS students. May be conducted on or off campus. Work off campus requires additional direction by an off-campus supervisor. Students must receive approval from their supervising instructor and the Director of RTC before registering.
Credits: variable to 6.0; Repeatable to a Max of 6
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Rhetoric & Tech Communication
HUC 5931 - Oral, Written and Visual Communication Pedagogies
A study of pedagogical techniques, technologies, evaluation, and assessment. Topics may include practical strategies and theories of rhetorical analysis, reflective speaking practices, critical visual design, and composition. GTAs in the RTC program in their first year of teaching are required to enroll in two consecutive semesters of this course.
Credits: 2.0; Repeatable to a Max of 4
Lec-Rec-Lab: (0-1-1)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate

HUC 5932 - Practicum in Teaching Technical Communication
Principles of technical and scientific communication pedagogies and practices. Offers guidance in assignment design, institutional assessment, and policy development through discussion, classroom observation, and reading. One semester required for GTIs new to teaching HUC3120.
Credits: 1.0; Repeatable to a Max of 2
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate

HUC 5933 - Practicum in Modern Language Pedagogy
Discussion and development of effective pedagogical practices and reading of research, scholarship, and theory of modern language pedagogy. GTAs will observe modern language classes regularly and reflect on their own and others’ practices. Required of all GTAs in the RTC program in their first year of language teaching at MTU.
Credits: 1.0; Repeatable to a Max of 2
Lec-Rec-Lab: (0-1-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

HUC 5934 - Practicum in Teaching Communications
Principles of the practice and pedagogy of teaching communications. Offers guidance in class and assignment design, class policy, options for readings, and strategies for teaching. One semester required for graduate students new to teaching communications.
Credits: 1.0; Repeatable to a Max of 2
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate

HUC 5975 - Full Time Master's Research
Open to students who have successfully completed all the required courses as well as the required number of credits for the master's degree. Students in this course are involved in full-time research. Tuition for this course is charged at the graduate full-time research rate. Students enrolled in this course may not register for any other courses.
Credits: 9.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-9-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

HUC 5990 - Thesis
Individual research or scholarship under the direction of a graduate faculty advisor. Open to students in the master's program in rhetoric and technical communication. Students must meet with their advisors before registering.
Credits: variable to 10.0; Repeatable to a Max of 10; Graded Pass/Fail Only
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Rhetoric & Tech Communication

HUC 5991 - Special Projects
Individual projects under the direction of a graduate advisor. Open to master's students in RTC only. Students must meet with their advisors before registering.
Credits: variable to 6.0; Repeatable to a Max of 6
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Rhetoric & Tech Communication

HUC 6001 - Special Topics in RTC
The study of special topics within or across the areas of rhetoric, technical communication, and the humanities.
Credits: variable to 3.0; Repeatable to a Max of 9
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

HUC 6010 - Special Topics in Communication
In-depth examination of topics in communication.
Credits: 3.0; Repeatable to a Max of 9
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

HUC 6020 - Special Topics in Composition
In-depth examination of theoretical perspectives on composing. May include discussion of current-traditional, expressionist, social constructionist, and postmodern perspectives.
Credits: 3.0; Repeatable to a Max of 9
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

HUC 6040 - Special Topics in Literature
Advanced study of topics in American, British, and world literature.
Credits: 3.0; Repeatable to a Max of 9
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

HUC 6050 - Special Topics in Modern Languages and Literatures
Advanced study of topics in modern languages and literatures. May include intercultural studies of non-English literature and film around an integrated theme; the study of non-English fiction and non-fiction with attention to theoretical and critical approaches; or more applied studies such as language for special purposes, second-language acquisition, and translation.
Credits: 3.0; Repeatable to a Max of 9
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

HUC 6060 - Special Topics in Philosophy
Advanced study of selected topics in philosophy. Possible topics include philosophy of literature, philosophy of mind, continental European philosophy, analytic philosophy, theories of truth, philosophical issues in cognitive science, and contemporary feminist philosophy.
Credits: 3.0; Repeatable to a Max of 9
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

HUC 6070 - Special Topics in Rhetoric
Advanced study of special topics in rhetorical theory or history, such as women in rhetorical history, the sophists, non-Western rhetorics, Aristotelian rhetoric, cultural backgrounds to the history of rhetoric, and rhetorical criticism.
Credits: 3.0; Repeatable to a Max of 9
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

HUC 6080 - Seminar in Technical Communication
May include study of the theoretical backgrounds of technical communication, the history of technical communication, rhetoric of technical communication, technical communication program administration, and technical communication pedagogy.
Credits: 3.0; Repeatable to a Max of 9
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

HUC 6110 - Special Topics in Contemporary Critical Theories
Study of particular contemporary theoretical perspectives that are influential in rhetoric and technical communication research. Topics might include cultural studies, theories of representation, feminist theory, marxist theory, postmodern theory, or intensive study of influential individual theorists.
Credits: 3.0; Repeatable to a Max of 9
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

HUC 6111 - Special Topics in Gender Studies
An inquiry into the ways in which gender is constituted within and affects rhetorical, representational, and communicative processes, situations, and structures.
Credits: 3.0; Repeatable to a Max of 9
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

HUC 6112 - Special Topics in New Media
A study of the design and evaluation of interactive texts on the computer, with emphasis on critical and theoretical issues raised by the visuality, shifting word-image ratio, and interactivity possible on computer screens.
Credits: 3.0; Repeatable to a Max of 9
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate
A critical examination of selected topics in visual representation, with an emphasis on the theoretical, industrial, cultural, international and national, and aesthetic contexts that inform an understanding of particular visual media. May include such topics as genre studies, reception theory and theories of spectatorship, gender and visual representation, etc.

Credits: 3.0; Repeatable to a Max of 9
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

HU 6900 - Independent Study
Guided research under the direction of a member of the graduate faculty. Open to advanced doctoral students in RTC only. Students must meet with their supervising instructor and receive approval of their study plan from the Director of RTC before registering.

Credits: variable to 6.0; Repeatable to a Max of 6
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Rhetoric & Tech Communication

HU 6901 - Directed Reading
Directed reading in a focused area under the direction of a member of the graduate faculty, for advanced PhD students in RTC. Credit varies according to the nature of the reading. Students must file a plan of study and receive approval from the supervising faculty and the Director of RTC before registering.

Credits: variable to 6.0; Repeatable to a Max of 9
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Rhetoric & Tech Communication

HU 6902 - Internship
Work experience under the direction of a member of the graduate faculty, for advanced PhD students. May be conducted on or off campus. Work off campus requires additional direction by an off-campus supervisor. Students must receive approval from their supervising instructor and the Director of RTC before registering.

Credits: variable to 6.0; Repeatable to a Max of 6
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Rhetoric & Tech Communication

HU 6975 - Full-Time Doctoral Research
Open to students who have successfully completed all required courses as well as the comprehensive and proposal defense exams. Students in this course are involved in full-time research. Tuition for this course is charged at the graduate full-time research rate. Students enrolled in this course may not register for any other course.

Credits: 9.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-4-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

HU 6990 - Doctoral Research
By arrangement with the instructor directing the PhD dissertation

Credits: variable to 10.0; Repeatable to a Max of 10; Graded Pass/Fail Only
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required

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, Summer
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, Spring
Restrictions: Must be enrolled in one of the following Major(s): Comm and Culture Studies, Health and Physical Education, Theatre & Entertain Tech (BA), Scientific & Tech Comm (BS), Psychology, Social Sciences, Liberal Arts with History Opt, Scientific & Tech Comm (BA), Humanities, Liberal Arts

MA 1030 - College Algebra I
Part one of a two semester series for students whose algebraic preparation is not sufficient for MA1032. Topics include numerical pre-algebra skills (fractions and decimals) and basic algebra skills (exponents, polynomials, rational expressions, roots, equations and inequalities).

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring, Summer
Co-Requisite(s): MA 0030

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
Pre-Requisite(s): MA 1031

MA 1032 - Data, Functions, & Graphs Plus
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: (0-3-2)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): ACT Mathematics >= 19 or SAT Mathematics >= 500

MA 1135 - 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)

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: (0-4-0)

MA 1161 - Calculus with Technology II
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 MA1160, going at a slower pace and incorporating cooperative learning study skills.

Credits: 5.0
Lec-Rec-Lab: (0-5-0)

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 2010 - Recreational Mathematics
Topics include such things as fair division, time travel, maze threading, logic puzzles and paradoxes, famous math problems and solutions, cryptarithm puzzles, how to use and misuse maps, mathematical humor, symmetry and coloring as problem-solving strategies, error-correcting codes, some transfinite arithmetic, and topology of compact surfaces.
Credits: 2.0
Lec-Rec-Lab: (0-2-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2001-2002 academic year

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: (0-4-0)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): MA 1660 or MA 1661 or MA 1135

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, Computer Science
Pre-Requisite(s): MA 1660 or MA 1161

MA 2321 - Elementary Linear Algebra
Offered first half of semester, to be taken concurrently with MA3251. 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, Computer Science
Co-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. Course prerequisite is any math class numbered MA1090 or higher.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): MA 1660 or MA 1161

MA 2710 - Introduction to Statistical Analysis
Introduction to statistical reasoning and methods. Topics include uses and abuses of statistics, sources of data and data quality, graphical and descriptive methods, correlation and regression, probability and statistical inference. Labs involve data generation and analysis aided by statistical software. Not open to students with credit in MA2270 or MA3710.
Credits: 3.0
Lec-Rec-Lab: (0-2-1)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Major(s): Mathematics
Pre-Requisite(s): MA 1160 or MA 1161

MA 2970 - 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 MA3710.
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 1032 or MA 1031 or ACT Mathematics => 26

MA 2990 - Elementary Topics in Mathematics
Students study a particular area in mathematics ordinarily not covered in existing courses. Intended for first- or second-year students.
Credits: variable to 4.0; Repeatable to a Max of 6
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required

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: (0-4-0)
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, Computer Science
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, Computer Science
Pre-Requisite(s): MA 2160

MA 3530 - 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 3530 - Mathematical Modeling with Differential Equations
Creating differential equation models for physical problems such as population dynamics, kinetic, 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 MA3560.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): MA 2160 and (MA 2320 or MA 2321 or MA 2330)

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 MA2720.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): MA 2160

MA 3720 - Probability
Introduction to probabilistic methods. Topics include probability laws, distribution theory, and limit theorems; elementary statistics, parameter estimation, reliability; introduction to random processes and their properties.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): MA 3160

MA 3810 - Introduction to Actuarial Mathematics
Covers measurement of interest, including accumulated and present values, nominal and effective rates of interest and discount. Annuities certain, including continuous increasing and decreasing cases. Calculation of yield rates, amortization schedules, and sinking funds. Introduction to life contingencies.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): MA 3160

MA 3811 - Actuarial Exam Workshop
Credits: 1.0; Repeatable to a Max of 3; Graded Pass/Fail Only
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): MA 3160

MA 3910 - Techniques for Teaching Mathematics
Teaching strategies focus on the use of history, math manipulatives, problem solving, models, and technology in the secondary mathematics classroom.
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): MA 3924

MA 3924 - 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 3930 - Theory of Games
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Pre-Requisite(s): MA 2320 or MA 2321 or MA 2330

MA 3990 - 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

MA 4208 - 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 2320 or MA 2321 or MA 2330

MA 4209 - 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: Spring
Pre-Requisite(s): MA 3160

MA 4211 - Information Theory and Data Compression
An introduction to information theory and data compression. Topics include information and entropy, channel and channel capacity, Kraft-McMillian inequality, maximum likelihood decoding, reliability, Shannon's theorem, lossless data compression, arithmetic coding, higher order modeling, adaptive methods, dictionary methods, transform methods, and image compression.
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): MA 3210

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MA 4310 - Abstract Algebra
Detailed study of abstract algebra: elementary number theory (congruences, quadratic residues, arithmetic functions), group theory (monoids, permutation groups, homomorphisms, quotient, Lagrange's theorem, finite abelian groups, Sylow's theorems), ring theory (domains, prime and maximal ideals, quotient, 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: Fall
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 2320 or MA 2321 or MA 2330) and MA 3160 and 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: Spring, Summer
Pre-Requisite(s): (MA 3520 or MA 3521 or MA 3530 or MA 3560) and MA 3160

MA 4520 - Integral Transforms, Special Functions, and Series Solutions to ODEs and Asymptotics
Laplace, Fourier, and other integral transforms and methods; special functions; series methods to solve ordinary differential equations.
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): (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 - Dynamical Systems: Control and Chaos
Ordinary differential equations and dynamical systems via a modern geometric approach, including physical and engineering applications. May include chaotic phenomena and fractals or elements of control theory.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2000-2001 academic year
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 interactive 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 - Finite Difference Methods for PDEs
Derivation, analysis, and implementation of finite difference methods; applications to fluid mechanics, elasticity, heat conduction, acoustics, or electromagnetism. Difference equations, Taylor series, stability, and convergence. Finite difference methods for partial differential equations; alternate methods (spectral, finite element, or particle) for discretizing space.
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 4625 - Finite Element Methods
Theory and practical applications of finite element methods in fluid mechanics, elasticity, heat transfer, and electricity and magnetism. Topics include variational principles, elementary function space concepts, finite element methodology, convergence, errors, and element selection.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): (MA 3520 or MA 3521 or MA 3530 or MA 3560) and MA 3160

MA 4630 - Numerical Methods
Solution of nonlinear equations in one variable, interpolation, polynomial approximation, numerical integration/differentiation, and numerical solution of initial-value problems.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2000-2001 academic year
Pre-Requisite(s): (MA 3520 or MA 3521 or MA 3530 or MA 3560) and MA 3160

MA 4635 - Numerical Methods for Integral Equations
Includes quadrature and quadrature methods for solving integral equations that occur in many scientific disciplines (imaging, aerodynamics, etc.).
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): MA 3530

MA 4710 - Regression Analysis
Covers simple, multiple, and polynomial regression; estimation, testing, and prediction; weighted least squares, matrix approach, dummy variables, multicolinearity, 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 2720 or MA 3710

MA 4720 - Design and Analysis of Experiments
Covers construction and analysis of completely randomized, randomized block, incomplete block, 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

MA 4730 - Nonparametric Statistics
Survey of distribution free statistical inference procedures. Topics include a review of probability and distribution theory, one sample, paired samples, multi-sample location tests, tests of independence and related measures of association, goodness-of-fit tests and tests based on the cumulative distribution function.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): MA 2710 or MA 2720 or MA 3710
MA 4740 - Sampling Methods
Topics include survey construction, sources of error in surveys, estimation of population parameters from simple random, stratified, systematic, and multistage samples, effects of and remedies for non-response, hypothesis testing survey data, and other topics as time permits. Students cannot receive credit for both MA4740 and MA5740.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand

MA 4750 - Applied Multivariate Statistics
An introduction to analysis of multidimensional data with emphasis on applications. Topics include inference for multivariate normal distribution, classification, cluster analysis, dimension reduction.
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

MA 4760 - Mathematical Statistics I
Covers probability set functions and distributions, multivariate distributions, special distributions, distributions of functions of random variables, and limiting distributions.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): MA 3720

MA 4770 - Mathematical Statistics II
Point estimation, confidence intervals, sufficient statistics, Bayesian estimation, the Rao-Cramer inequality, hypothesis testing, including optimal tests, nonparametric methods.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): MA 4760

MA 4810 - Life Contingencies
Measurement of mortality, life tables, commutation functions. Covers all basic forms of life insurance and life annuities, including gross and net premiums, reserves, cash values, and expense loadings. Advanced topics may include stationary populations, joint and multiple life functions, multiple decrement tables and dividends.
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 3720 or MA 3810

MA 4820 - Loss Distributions and Credibility Theory
Credibility theory addresses methods for updating statistical estimates as new data becomes available. Loss distribution studies probability distributions that are used for modeling the outcomes of insurance claims.
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 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
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): UN 2002

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

MA 5201 - Combinatorial Algorithms
Basic algorithmic and computational methods used in the solution of fundamental combinatorial problems. Topics may include but are not limited to backtracking, hill-climbing, combinatorial optimization, linear and integer programming, and network analysis.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2001-2002 academic year
Restrictions: Must be enrolled in one of the following Level(s): Graduate

MA 5211 - Discrete Optimization
Optimization problems (traveling salesman, minimal spanning tree, linear programming, scheduling, etc.), simplex algorithm, primal-dual algorithms, complexity, matching, weighted matching, spanning trees, matroid theory, integer linear programming, approximation algorithms, branch-and-bound, local search, polyhedral theory.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2002-2003 academic year

MA 5221 - Graph Theory
Review of basic graph theory followed by one or more advanced topics which may include topological graph theory, algebraic graph theory, graph decomposition or graph coloring.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): MA 4209 and MA 5301

MA 5222 - Design Theory
Methods for the construction of different combinatorial structures such as difference sets, symmetric designs, projective geometries, orthogonal latin squares, transversal designs, steiner systems and tournaments.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): MA 5301

MA 5231 - Error-Correcting Codes
Basic concepts, motivation from information transmission, finite fields, bounds, optimal codes, projective spaces, duality and orthogonal arrays, important families of codes, MacWilliams' identities, applications.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2002-2003 academic year
Pre-Requisite(s): MA 5301

MA 5232 - Cryptography
Classical cryptography, public key systems, signature schemes, key exchange, authentication codes, secret sharing schemes, protocols.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2002-2003 academic year
Pre-Requisite(s): MA 5221

MA 5301 - Finite Groups and Finite Fields
Theory of finite groups, their actions and applications. Review of basic group theory (Sylow theorems). Simple groups and group actions (transitivity), Symmetric and alternating groups, linear groups and more general classical groups. Applications: finite fields, designs, finite geometries.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): MA 4310

MA 5302 - Algebra II
Introduction to polynomial rings, finite fields and field extensions. Review of basic notions concerning rings, polynomials and power series. General theory of finite and algebraic field extensions. The basics of Galois theory (field extensions and their Galois groups).
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Pre-Requisite(s): MA 5301
MA 5401 - Real Analysis
A graduate-level study of the Lebesgue integral including its comparison with the Riemann integral; the Lebesgue measure, measurable functions and measurable sets. Integrable functions, the monotone convergence theorem, the dominated convergence theorem, and Fatou's lemma.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2005-2006 academic year
Restrictions: Must be enrolled in one of the following Level(s): Graduate

MA 5405 - Complex Variables
The Cauchy-Goursat theorem; the argument principle and winding numbers; the Riemann mapping theorem; conformal mappings and application in hydrodynamics; Poisson's formula and the Dirichlet problem for harmonic functions; analytic continuation; infinite products; the gamma and zeta functions, and the distribution of primes.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2001-2002 academic year
Restrictions: Must be enrolled in one of the following Level(s): Graduate

MA 5504 - Mathematical Modeling
Construction, analysis, and testing of mathematical models (continuum, discrete, deterministic, or stochastic). Possible models include acoustical, biological, chemical, dynamical, ecological, economics, electromagnetics, financial, geological, mechanical, medical, metallurgical, optical, process, robotics, systems, thermal, material (solid, liquid, gas, plasma, multiphase) dynamics.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2003-2004 academic year
Restrictions: Must be enrolled in one of the following Level(s): Graduate

MA 5510 - Ordinary Differential Equations I
First order equations, general theory of linear equations, constant coefficient equations, matrix methods, singular points, infinite series methods, plane autonomous systems.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2002-2003 academic year
Pre-Requisite(s): MA 4450 and MA 4330

MA 5524 - Functional Analysis
Metric spaces, Banach spaces, Hilbert spaces, fundamental convergence and mapping theorems, spectral theory, weak topologies and weak compactness, unbounded operators and their adjoints, fixed point theorems.
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 4330 or MA 4610) and MA 4450

MA 5545 - Applied Integral Equations
Linear integral equations of the first and second kind, Fredholm theory with applications, Hilbert-Schmidt theory with applications, computational methods for approximate solutions of integral equations.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2000-2001 academic year
Pre-Requisite(s): MA 4450 and MA 4330

MA 5548 - Mathematical Continuum Mechanics
Langrangian and eulerian coordinate systems, stress and strain in elastic, viscoelastic, and plastic materials. Constitutive equations, viscosity, balance laws of fluid and solid mechanics, elasticity, Euler equations, and Navier-Stokes equations.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2003-2004 academic year
Restrictions: Must be enrolled in one of the following Level(s): Graduate

MA 5556 - Partial Differential Equations
Theory of partial differential equations. Covers classification, appropriate boundary conditions and initial conditions, PDEs of mathematical physics, characteristics, Green's functions, and variational principles.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2003-2004 academic year
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): MA 4450 and MA 4330
MA 5731 - Linear Models
A unified development of linear statistical models that includes the following topics: matrices and quadratic forms, normal and chi-square distribution theory, ordinary and generalized least squares modeling, estimability, estimation and tests of hypothesis.
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): MA 4710 and MA 4720 and MA 4760 and MA 4330

MA 5740 - Advanced Sampling Methods
Runs concurrently with MA 4740 and covers the same topics as MA 4740, but students meet an additional one hour per week to prove results and discuss advanced topics. Students cannot receive credit for both MA 4740 and MA 5740.
Credits: 4.0
Lec-Rec-Lab: (0-4-0)
Semesters Offered: On Demand
Pre-Requisite(s): MA 5701 and MA 4770

MA 5750 - Statistical Genetics
Application of statistical methods to solve problems in genetics such as locating genes. Topics include basic concepts of genetics, linkage analysis and association studies of family data, association tests based on population samples (for both qualitative and quantitative traits), gene mapping methods based on family data and population samples.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2006-2007 academic year

MA 5761 - Computational Statistics
Introduction to computationally intensive statistical methods. Topics include resampling methods, Monte Carlo simulation methods, smoothing techniques to estimate functions, and methods to explore data structure. This course will use the statistical software S-plus.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): MA 4770(C)

MA 5791 - Categorical Data Analysis
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2005-2006 academic year

MA 5901 - Teaching College Mathematics I
Survey key issues in undergraduate mathematics education, including course preparation, assessment, student learning, developing assignments, instructional strategies, technology, motivating students and institutional resources. The lab involves practical training in the computer algebra system used in the mathematics lab.
Credits: 3.0
Lec-Rec-Lab: (0-2-1)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Major(s): Mathematical Sciences, Mathematics; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

MA 5903 - Introduction to Scientific Programming
Topics include program control, input/output, data structures, procedural and modular programming, and floating point arithmetic. Emphasis on techniques and structures for computational mathematics. Requires programming assignments and projects.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: On Demand

MA 5920 - Statistics for Educators
Intended for practicing teachers, this course focuses on strengthening understanding of statistical topics required at the secondary level and associated pedagogical issues. Includes descriptive statistics, probability, normal distribution, interpretation/analysis of univariate and bivariate data, and exploring variability in systems.
Credits: 4.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

MA 5975 - Full Time Master's Research
Open to students who have successfully completed all the required courses as well as the required number of credits for the master's degree. Students in this course are involved in full-time research. Tuition for this course is charged at the graduate full-time research rate. Students enrolled in this course may not register for any other course.
Credits: 9.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-9-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

MA 5980 - Special Topics in Mathematics
Special topics in mathematics.
Credits: variable to 12.0; Repeatable to a Max of 48
Semesters Offered: Fall, Spring, Summer

MA 5999 - Graduate Research in Mathematics
Original investigation in theoretical, or applied mathematics, and submission of a thesis in partial fulfillment of the requirements for the master's degree in mathematics.
Credits: variable to 12.0; Repeatable to a Max of 48; Graded Pass/Fail Only
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

MA 6201 - Finite Geometries
Introduction to finite geometries and its links to groups and codes. Topics include projective and affine geometries over finite fields, geometric description of error-correcting codes, bilinear forms and their groups (the classical groups, geometric algebra), group geometries (Dynkin diagrams, projective planes, generalized quadrangles), coordinatization of projective planes.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2003-2004 academic year
Pre-Requisite(s): MA 5301

MA 6301 - Permutation Groups and Enumeration
Introduction to finite groups, permutations and their applications. Covers a review of finite group theory (Lagrange's theorem, simple groups, p-groups, Sylow theorems), permutation groups (Burnside's lemma, orbit formula, primitivity, t-fold transitivity, linear groups, the Mathieu groups). Applications include Polya theory (counting group orbits) and its use in chemistry, construction of combinatorial designs.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2003-2004 academic year
Pre-Requisite(s): MA 5301

MA 6302 - Algebraic Curves and Algebraic Codes
Introduction to the theory of algebraic curves, equivalent algebraic function fields (main theorems Riemann-Roch theorem and Hasse-Weil theorem) and the construction of error-correcting codes from algebraic curves with finite fields of constants.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2002-2003 academic year
Pre-Requisite(s): MA 5301

MA 6500 - Advanced Topics in Statistics
Topics may include but are not limited to experimental designs, methods of quality improvement, discrete data analysis, regression analysis, sampling theory, multivariate methods, resampling methods, statistical computing, integral and measure theory, stochastic processes, asymptotic methods, optimization, modeling of nonparametric and parametric statistics.
Credits: variable to 12.0; Repeatable to a Max of 48
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

MA 6701 - Probability
Review of discrete probability, probability measures, random variables, distribution functions, expectation as a Lebesgue-Stieltjes integral, independence, modes of convergence, laws of large numbers and iterated logarithms, characteristic functions, central limit theorems, conditional expectation, martingales, introduction to stochastic processes.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Pre-Requisite(s): MA 3720 and MA 4450

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.

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 2200 - Thermodynamics
Introduces fundamental concepts of heat and power. Presents property relationships incompressible substances, simple pure substances, and ideal gases. Applies the first and second laws of thermodynamics to the analyses of processes for open and closed systems. Also covers thermodynamic 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): MEEM 2110

MEEM 2500 - Integrated Design and Manufacturing
Focuses on practical aspects of design and manufacturing. Covers fundamentals of manufacturing processes and includes weekly lab providing hands-on experiences with manufacturing issues that influence component design. Incorporates computer-aided manufacturing tools.

Credits: 4.0
Lec-Rec-Lab: (0-3-3)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Major(s): Engineering, Mechanical Engineering Tech, Engineering-Manufacturing, Mechanical Engineering, Industrial Technology, Biomedical Engineering, Engineering-Mechanical Design
Pre-Requisite(s): ENG 1102 and (MY 2100(C) or MET 1540(C) or TE 1020)

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 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(C) or ENG 2120) and MEEM 3230(C) and MEEM 3700(C) and EE 3010

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, 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 and (MA 3520 or MA 3521 or MA 3530 or MA 3560)

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 3700 - Mechanical Vibrations

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring, Summer
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 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
Restrictions: Must be enrolled in one of the following Major(s): Mechanical Engineering
Pre-Requisite(s): MEEM 2500

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 Eng-Eng Mechanics, Mechanical Engineering; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Senior

MEEM 4150 - Intermediate Mechanics of Materials
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
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 transducer.
Credits: 3.0
Lec-Rec-Lab: (0-2-3)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Level(s): Undergraduate
Pre-Requisite(s): MEEM 2150

MEEM 4170 - Failure of Material 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 MEEM4180 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, solar energy, wind turbines, fuel and solar cells.
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): MEEM 3230(C)

MEEM 4210 - Computational Methods in Thermal Sciences
Introduces computational methods used to solve thermodynamic, fluid mechanic, and heat transfer problems. Discusses theoretical and practical aspects. Modern computer-based tools are used to reinforce principles and introduce advanced topics in thermodynamics, fluid mechanics, and heat transfer.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
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: Fall
Pre-Requisite(s): MEEM 3210

MEEM 4240 - Combustion & Air Pollution
Introduces physico-chemical processes of combustion, including the phenomena of ignition, extinction, flame propagation, detonation, solid propellant combustion, fuel spray combustion, and pollutant formation. Also addresses analysis and design of an air pollution control system with a special focus on automotive emissions.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring, 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
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 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
Restrictions: Must be enrolled in one of the following Major(s): Mechanical Engineering, Mechanical Eng-Eng Mechanics, Mechanical Engineering-Manufacturing; May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): ENG 1102

MEEM 4403D - Computer-Aided Design Methods (Distance Program)
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: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following College(s): College of Engineering
Pre-Requisite(s): ENG 1102

MEEM 4404 - Mechanism Syn/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: 4.0
Lec-Rec-Lab: (0-3-2)
Semesters Offered: Fall, Spring
Pre-Requisite(s): MEEM 3502(C)

MEEM 4404D - Mechanism Syn/Dynamic Modeling (Distance Program)
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, Summer
Pre-Requisite(s): MEEM 3502(C)

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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 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: 4.0
Lec-Rec-Lab: (0-3-2)
Semesters Offered: Spring
Pre-Requisite(s): MEEM 2500

MEEM 4610D - 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. Credit may not be received for more than one of the following: MEEM 4610, 4610D and 5610.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Campus(s): Extended University Programs
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 4615D - Metal Forming Processes (Distance Program)
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: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
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
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
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 4635 - 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: Spring
Pre-Requisite(s): MY 2100 and MEEM 2150 and MEEM 3210 and MEEM 3230(C)

MEEM 4640 - 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: (0-2-2)
Semesters Offered: Fall, Spring
Pre-Requisite(s): MEEM 3502(C)

MEEM 4650 - Quality Engineering
Introduction to the concepts and methods of quality and productivity improvement. 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. Credit may not be received for both MEEM4650 and MEEM5650.
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): MA 3710 or MA 3720

MEEM 4655 - Production Planning
Provides current issues, such as just-in-time production and reengineering, while covering fundamental production planning topics as scheduling, job design, inventory and forecasting. Provides the fundamental essence of the firm--how its products are made 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 from 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 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 classic 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, Summer
Pre-Requisite(s): MEEM 3700

MEEM 4700D - Dynamic Systems and Controls (Distance Program)
Analysis of dynamic systems, use of Laplace transforms to solve differential equations, design of control systems using classic 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: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Permission of department required
Pre-Requisite(s): MEEM 3700

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MEEM 4701 - Analyze 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): MEEM 4700(C)

MEEM 4900 - Senior Design I
Students work in teams on "open-ended" engineering design projects - most with industrial sponsors - developing original and creative solutions to real engineering problems. Lectures include the design process, design tools, project management, engineering communication/oral/written), engineering ethics, and intellectual property.
Credits: 3.0
Lec-Rec-Lab: (2-0-3)
Semesters Offered: Fall, Spring
Pre-Requisite(s): MEEM 3000(C) and MEEM 3502(C)

MEEM 4900D - Senior Design I
Introduces computer-aided design (CAD) and finite element methods as tools for engineering design. Senior projects are selected/assigned with initial concepts evaluated using CAD methods. Covers project management methods and emphasized communications, oral and written.
Credits: 3.0
Lec-Rec-Lab: (2-0-3)
Semesters Offered: On Demand
Pre-Requisite(s): MEEM 4405 and MEEM 4992D and MEEM 4993D

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 4991D - Solid Modeling (Distance Program)
Develops a working knowledge of parametric solid modeling techniques for building, modifying, and constructing virtual automotive components and assemblies, including the use of parametric constraints, feature creation and editing techniques, and development of freeform features.
Credits: 6.0
Lec-Rec-Lab: (0-6-0)
Semesters Offered: On Demand

MEEM 4992D - Vehicle Packaging (Distance Program)
Explores the designer's role in vehicle packaging issues and practices, such as drive/passenger ergonomics, engine compartment serviceability, and clearance parameters; door, deck and hood requirements; suspension and exhaust system considerations; heating/cooling system provisions and limitations; and fuel system factors.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Pre-Requisite(s): MEEM 2500 and MEEM 4992D and MY 2100

MEEM 4994D - Powertrain Packaging
Explores the designer's role in powertrain packaging issues and practices such as overview of major dynamic phenomenon that characterizes powertrain behavior. Emphasis on interaction between subsystems.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Pre-Requisite(s): MEEM 4991D or MEEM 4403D and (MEEM 215D or MEEM 2150)

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

MEEM 5110 - Continuum Mechanics/Elasticity
Covers development of Cartesian tensors and indicial notation applied to vector analysis; analysis of stress, principal stresses, invariants, strain tensors, material derivatives, and continuity equations; basic conservation laws and constitutive relationships; the theory of elasticity, including 2-D problems in plane stress/strain, stress functions, and 3-D problems with polar symmetry.
Credits: 3.0
Lec-Rec-Lab: (3-0-3)
Semesters Offered: Fall, Spring
Pre-Requisite(s): MEEM 2150 and MEEM 4992D or MEEM 5110

MEEM 5150 - Advanced Mechanics of Matls
A critical study of the basic concepts of stress, strain, and constitutive laws of solids, the physical significance of principle stresses, stress deviator and octahedral stress. Covers failure theories; two-dimensional elasticity theory; mechanics of sub-micron structures; torsion of prismatic bars, thick pressure vessels; special topics in beam theory; elements of elastic stability.
Credits: 3.0
Lec-Rec-Lab: (3-0-3)
Semesters Offered: Fall, Spring
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior
Pre-Requisite(s): MEEM 2150 and MEEM 5110
MEEM 5160 - Experimental Stress Analysis: Review of elastic stress-strain relationships. Covers theory and use of resistive strain gages, strain gage circuits, rosette analysis, static and dynamic strain measurement; discusses other current strain measuring techniques; introduces photoelasticity, Moire, and other optical techniques.

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, Junior
Pre-Requisite(s): MEEM 2150

MEEM 5170 - Finite Element and Variational Methods in Engineering: Presents fundamental concepts of variational methods including Rayleigh-Ritz technique. Introduces foundations of finite element modeling through direct method, variational method, and weighted residual method. Reviews elements commonly used in static structural analysis and heat transfer problems. Advanced topics such as nonlinearity and time-dependent problems may also be discussed.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Level(s): Graduate

MEEM 5180 - Mechanics of Composite Mats: Introduces engineering properties and advantages of fibrous composites, the governing equations of mechanics of anisotropic, laminated materials. Develops micromechanics methods for predicting the elastic properties of the composite and classical lamination theory, including hygrothermal effects, and applies them to stress and failure analysis of composite structures.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2009-2010 academic year
Restrictions: Must be enrolled in one of the following Class(es): Freshman, Sophomore, Junior
Pre-Requisite(s): MEEM 2200

MEEM 5200 - Advanced Thermodynamics: A study of the principles of thermodynamics, including fundamental concepts and introduction of the analytical treatments of the first, second and combined first and second laws of thermodynamics. Topics include irreversibility, availability (exergy), thermodynamic relations, mixtures, chemical reactions, and chemical equilibrium.

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
Pre-Requisite(s): MEEM 2200

MEEM 5205D - Comp Methods in Thermal Sci (Distance Program): Introduces computational methods used to solve thermodynamic, fluid mechanic, and heat transfer problems. Discusses theoretical and practical aspects. Modern computational tools are used to reinforce principles and introduce advanced topics in thermodynamics, fluid mechanics, and heat transfer.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Pre-Requisite(s): MEEM 3230

MEEM 5210 - Advanced Fluid Mechanics: Develops control volume forms of balance laws governing fluid motion and applies to problems involving rockets, pumps, sprakers, etc. Derives and studies differential forms of governing equations for incompressible viscous flows. Some analytical solutions are obtained and students are exposed to rationale behind computational solution in conjunction with CFD software demonstration. Also covers qualitative aspects of lift and drag, loss of stability of laminar flows, turbulence, and vortex shedding.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): MEEM 3210

MEEM 5230 - Advanced Heat Transfer: Advanced topics on conduction, convection, radiation, and heat exchangers are covered. Emphasis is on problem formulation, and exact solutions, with some coverage of empirical results and computational techniques.

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, Junior
Pre-Requisite(s): MEEM 3230

MEEM 5240 - Comp Fluid Dynamics for Engg: Introduces finite-difference and finite-volume methods used in solving fluid dynamics and heat transfer problems. Covers numerical grid generation, turbulence modeling, and application to some selected problems.

Credits: 3.0
Lec-Rec-Lab: (3-0-3)
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 5250 - Internal Combustion Engines II: Advanced topics in internal combustion engines with emphasis on CI operation, modeling of engines, modeling of combustion processes, tribology, second law applications, and other topics of current interest.

Credits: 3.0
Lec-Rec-Lab: (3-0-3)
Semesters Offered: Fall, Spring - Offered alternate years beginning with the 2002-2003 academic year
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): MEEM 4220 and MEEM 5200

MEEM 5270 - Advanced Combustion: The objective is to understand basic combustion processes through detailed analysis. Introduces both analytical and modern experimental methods. Emphasizes liquid fuel combustion, flame propagation, and critical phenomena of ignition and extinction.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): MEEM 4240

MEEM 5280 - Phase-Change & Two-Phase Flows: Considers two-phase flow patterns for air-water, condensing, and boiling flows in the context of interface conditions (surface tension, etc.) and interfacial instabilities that lead to interfacial waves, droplet formation, etc. The course emphasizes development of model equations. Relevant experimental data leading to pressure drop correlations, interfacial shear model, etc., are discussed. The model equations and empirical correlations are used to estimate solutions of problems.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): MEEM 3230

MEEM 5401 - Design for Reliability: Emphasizes the importance of reliability in design, covering basic concepts of series, parallel, standby and mixed systems. Uses conditional probability and multimodedefunctions as methods for problem solution. Considers derating and reliability testing.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): MEEM 3501

MEEM 5404D - Mechanism Syn/Dynamic Modeling (Distance Program): Student 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: (3-0-3)
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): MEEM 3502(C)

MEEM 5405D - Intro to the Finite Element Method (Distance Program): 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: (0-3-0)
Restrictions: Must be enrolled in one of the following Level(s): Graduate
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 5408 - Design Automation
Students learn fundamental theories and techniques used in mechanical CAD software development. Useful to all students using CAD software in their research and students specializing in design. Basic software engineering, math topics, geometry, solid modeling, design knowledge, design manipulation, and internet will be covered.

Credits: 4.0
Lec-Rec-Lab: (0-4-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2004-2005 academic year
Restrictions: Must be enrolled in one of the following Level(s): Graduate

MEEM 5605D - Metal Forming Processes (Distance Program)
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: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): MEEM 2500 and MEEM 2150

MEEM 5610 - Advanced Machining Processes
Covers mechanics of 2-D and 3-D cutting and their extension to commonly used processes such as turning, boring, milling, and drilling. Topics include force modeling, surface generation, heat transfer, tool life and dynamics.

Credits: 4.0
Lec-Rec-Lab: (0-3-2)
Semesters Offered: Spring
Restrictions: Must not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior
Pre-Requisite(s): MEEM 2500

MEEM 5615 - Advanced Metal Forming
Introduces fundamentals of plasticity theory and applies to the analysis of deformation processes. Processes considered are forging, extrusion, wire drawing, bending, deep drawing, and stretch forming. Emphasizes sheet metal formability.

Credits: 4.0
Lec-Rec-Lab: (0-3-2)
Semesters Offered: Fall, Spring
Restrictions: Must not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior
Pre-Requisite(s): MEEM 3502 or MEEM 2150

MEEM 5625 - Precision Machining and Metrology
Presents theory and practice involved in the manufacturing and measuring of precision components. Topics include precision machining processes, precision machine/mechanism design, and dimensional metrology. Addresses current manufacturing challenges in the bearings, optics, and microelectronics industries.

Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Fall
Restrictions: Must not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior
Pre-Requisite(s): MEEM 3502 and MEEM 3700

MEEM 5640 - 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. No credit for both MEEM4640 MEEM5640.

Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): MEEM 3502(C)

MEEM 5645 - Numerical Analy Manuf Proc
Nonlinear FEM and BEM analyses, modeling of bulk forming processes, sheet forming processes, machining processes, casting processes, grinding of ceramics.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): MEEM 2500

MEEM 5650 - Advanced Quality Engineering
Stresses the concepts and methods for quality and productivity improvement. Topics include principles of Shewhart, Deming, Taguchi; meaning of quality; control charts for variables, individuals, and attributes; process capability analysis; variation of assemblies; Monte Carlo simulation, multi-variate situations; and computer-based workshops. No credit for both MEEM4650 and MEEM5650.

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
Pre-Requisite(s): MA 3710

MEEM 5653 - Life-cycle Engineering
Familiarizes students with the principles and techniques of life-cycle engineering. These techniques include design reviews, re-engineering, cost/benefit analysis, value engineering and design for "X." Upon completion, students should be adept at weighing the costs and benefits of product design decisions as they apply to a product from concept to retirement. Credit may not be received for both MEEM 4653D and MEEM 5653.

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
Pre-Requisite(s): MEEM 4900

MEEM 5655 - Introduction to Lean Manufacturing
Lean manufacturing is emerging globally as a paradigm by which business units must function to be globally competitive. Quality, cost, and delivery have become critical measures that impact profits and, in turn, the success of an organization. Significant improvements in all these three measures come from the continuous elimination of waste, or non-value added activities, in manufacturing. Numerous tools are available for the elimination of waste and making businesses lean. This course is intended to familiarize students with this new philosophy of lean manufacturing and arm them with a basic toolset that enables the identification, measurement, and elimination of non-value added activities.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2007-2008 academic year
Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following College(s): College of Engineering, School of Business & Economics

MEEM 5660 - Data Based Modeling & Control
System modeling and analysis from observed data for computer-aided design and manufacturing, providing differential equation models. 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. Uses illustrative applications to real-life data, including team projects.

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 5670 - Experimental Design in Engg

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, Sophomore, Junior

MEEM 5680 - Optimization I
Provides introductory concepts to optimization methods and theory. Covers the fundamentals of optimization, which is central to any problem involving engineering decision making. Provides the tools to select the best alternative for specific objectives.

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
MEEM 5685 - Environmentally Responsible Design and Manufacturing
Examines impact of engineering and, in particular, design/manufacturing decisions on the environment. Topics include sustainability; energy/material flows; risk assessment, life cycles, manufacturing process waste streams, product design issues, including disassembly/post-use product handling; techniques for pollution prevention. Requires course project. Credit may not be received for both MEEM4685 and MEEM5685.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, 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 5700 - Dynamic Meas/Signal Analysis
Assessment of measurement system requirements: transducers, conditioners, and displays of dynamic measurands. Time-, frequency-, probabilistic-, and correlatable-domain approaches to dynamic signal analysis: sampled data, discrete Fourier transforms, digital filtering, estimation errors, system identification, calibration, recording. Introduction to wavelet analysis. All concepts reinforced in laboratory and simulation exercises.
Credits: 4.0
Lec-Rec-Lab: (0-3-3)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): MA 4520

MEEM 5701 - Intermediate Dynamics
Intermediate study of several topics in engineering dynamics, including three-dimensional kinematics and kinetics, generalized coordinates, Lagrange's equation, and Hamilton's principle. Uses computer-aided dynamic simulation tools for analyzing dynamic systems.
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
Pre-Requisite(s): MEEM 2700

MEEM 5702 - Analytical Vibroacoustics
First in a series of two courses on vibro-acoustics to provide a unified approach to study noise and vibration. Emphasizes interaction between sound waves and structures. Presents advanced vibration concepts with computational tools. Discusses wave-modal duality.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): MEEM 3700

MEEM 5703 - Exp Methods Vibro-Acoustics
Covers operating data measurement and analysis, including multisource ODS. Includes signature analysis and order tracking; modal theory, modal scaling. FRF estimators; multiple input excitation techniques; parameter estimation methods; sound measurements and acoustic intensity; sound quality; field data acquisition, DAT; binaural recording and playback with equalization.
Credits: 4.0
Lec-Rec-Lab: (0-3-3)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): MEEM 5700 and MEEM 5702

MEEM 5705 - 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. A final project is required including analysis, design, and experimental demonstration. Cannot receive credit for both MEEM4705 and MEEM5705.
Credits: 4.0
Lec-Rec-Lab: (0-3-3)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): MEEM 4700

MEEM 5710D - NVH and Sound Quality (Distance Program)
Noise Vibration and Harshness (NVH) is an important design consideration in the automotive, appliance, and machine tool industry. This course presents the fundamental concepts of noise and vibration measurement, modeling, and control. Lectures are supported with hands-on testing and analysis.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): MEEM 3700

MEEM 57115 - Linear Systems Theory and Design
Overview of linear algebra, Modern Control: state-space based design of linear systems, observability, controllability, pole placement, observer design, stability theory of linear time-varying systems, Lyapunov stability, optimal control, Linear Quadratic regulator, Kalman filter, Introduction to robust control.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring - Offered alternate years beginning with the 2005-2006 academic year
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): MEEM 4700 or EE 4261 or MA 4330

MEEM 5795 - Full Time Master's Research
Open to students who have successfully completed all the required courses as well as the required number of credits for the master's degree. Students in this course are involved in full-time research. Tuition for this course is charged at the graduate full-time research rate. Students enrolled in this course may not register for any other course.
Credits: 9.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-9-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

MEEM 5990 - Special Topics
Study of selected subjects related to mechanical engineering or engineering mechanics.
Credits: variable to 6.0; May be repeated
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

MEEM 5994 - International Mechanical Engineering Field Experience
Field work and reporting from students in the Peace Corps Master's International Program in Mechanical Engineering.
Credits: 1.0; Repeatable to a Max of 9; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate
Must be enrolled in one of the following Major(s): Mechanical Engineering

MEEM 5999 - Graduate Research
Research/investigation on a topic related to mechanical engineering or engineering mechanics leading to the submission of a thesis or report in partial fulfillment of the requirements for the master's degree.
Credits: variable to 15.0; Repeatable to a Max of 30; Graded Pass/Fail Only
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate;
Must be enrolled in one of the following Major(s): Mechanical Engineering, Mechanical Eng-Eng Mechanics, Engineering Mechanics

MEEM 6000 - Graduate Seminar
Presentations/seminars on issues related to mechanical engineering and engineering mechanics. May include invited speakers from industry, government labs, and academe.
Credits: 1.0; Repeatable to a Max of 2
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate

MEEM 6110 - Advanced Continuum Mechanics
Presents fundamental concepts in hyperelasticity, damage mechanics, linear viscoelasticity, quasi-linear viscoelasticity, poroelasticity, continuum jump conditions, plasticity, and viscoplasticity. These theories are applied to describe the mechanical behavior of a wide range of engineering materials and biomaterials such as polymers, metals, soil, collagen, muscle tissue, bone tissue, and cartilage.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2008-2009 academic year
Restrictions: Must be enrolled in one of the following Level(s): Graduate;
Must be enrolled in one of the following College(s): College of Engineering
Pre-Requisite(s): MEEM 5110

MEEM 6120 - Dynamic Behavior of Materials
Covers the dynamic stress-strain aspects of material behavior, discusses elastic waves in bounded media, describes the Hopkinson bar, an experimental tool for the determination of the dynamic strength of materials, and includes impacts of bars and response of high strain rate.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand - Offered alternate years beginning with the 2001-2002 academic year
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): MEEM 2150 and MEEM 2700
MEEM 6310 - Engineering Fracture Mechanics
Development of the stress and deformation fields present near the tips of cracks. Uses elasticity solutions, plasticity corrections, and numerical methods in modeling these fields. Introduces fracture criteria and explains the various parameters used to develop these criteria.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2008-2009 academic year
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): MEEM 5110

MEEM 6230 - Conduction
Fundamental aspects of conductive heat transfer applied to steady-state and transient conditions. Studies multidimensional conduction problems with exact and approximate solutions techniques.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): MEEM 5230

MEEM 6240 - Convective Heat Transfer
An introduction to flow and boundary layer theory for forced and natural convection heat and mass transfer. Includes derivation and application of the equations for conservation of mass, energy, and momentum; dimensional analysis and correlation of experimental results.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): MEEM 5230

MEEM 6250 - Radiative Heat Transfer
Fundamentals of thermal radiation for black, gray, nongray, diffuse, and specular surfaces. Includes radiation combined with conduction and convection at boundaries; properties for radiation in absorbing, emitting, and scattering media; and the engineering treatment of gas radiation in enclosures.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): MEEM 5230

MEEM 6401 - Enng Design Optimization
Covers mathematical optimization methods useful for engineering design optimization. Includes classical methods as well as new techniques. Emphasizes practical applications and the selection of optimization methods for the solution of specific problems in design.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): MEEM 5230

MEEM 6670 - Data Dependent Systems
Modeling of systems from multiple series of observed data. Includes interpretation and characteristics of vector difference-equation models; impulse response functions and modal analysis; spectrum analysis of the contribution of various system components to the measured responses; application to process control and design.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): MEEM 4660 or MEEM 5660

MEEM 6702 - Nonlinear Sys Analy & Control
Studies nonlinear systems from perspective of analysis/control system design. Explores fundamental properties of nonlinear differential equations in addition to describing functions, phase plane analysis, stability/instability theorems. Develops and applies control system design approaches for nonlinear systems, including feedback linearization, quantitative feedback theory, sliding mode control, and backstepping.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): MEEM 6670

MEEM 6703 - Advanced Vibrations
Free and forced vibration of continuous systems with applications to strings, shafts, beams, plates and membranes. Problems formulated using Hamilton's principle and Lagrange's equations. Approximate methods of solution include the Rayleigh-Ritz method and Galerkin's method.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): MEEM 3700

MEEM 6705 - Advanced Dynamics
Systematic study of principles of mechanics from a modern perspective. Includes rates of change of position and orientation; angular velocity and acceleration; linear velocity and acceleration; generalized coordinates and velocities; properties of distributed mass; generalized active and inertia forces for holonomic and nonholonomic systems; potential energy, kinetic energy, and virtual work.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

MEEM 6975 - Full-Time Doctoral Research
Open to students who have successfully completed all required courses as well as the comprehensive and proposal defense exams. Students in this course are involved in full-time research. Tuition for this course is charged at the graduate full-time research rate. Students enrolled in this course may not register for any other course.

Credits: variable to 6.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-9-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

MEEM 6999 - Special Topics
Study of selected subjects related to mechanical engineering or mechanical engineering.

Credits: variable to 6.0; May be repeated
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

MEEM 6999 - Doctoral Research
Research/Investigation on a topic related to mechanical engineering or engineering mechanics leading to the submission of a dissertation in partial fulfillment of the requirements for the PhD degree.

Credits: variable to 15.0; Repeatable to a Max of 90; Graded Pass/Fail Only
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate

Mechanical Engrg Technology

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: Fall, Spring
Pre-Requisite(s): CH 1100 or CH 1110 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 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: Fall, 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): 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 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: On Demand
Pre-Requisite(s): MET 3242

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 4200 - Design of Experiments
This course provides basic knowledge required to develop statistical experiments to improve quality of process and products. The student will begin designing simple experiments and expand to apply advance principles to study interaction between variables. A strong foundation will be provided allowing the student to progress to Taguchi experimental design techniques.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Summer
Restrictions: Must be enrolled in one of the following Class(es): Sophomore, Junior, Senior
Pre-Requisite(s): MA 2710 or MA 2720 or MA 3710 or BA 2100

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
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): MET 3600

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 - Offered alternate years beginning with the 2009-2010 academic year
Pre-Requisite(s): MET 3250

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 - Offered alternate years beginning with the 2009-2010 academic year
Pre-Requisite(s): MET 3600

MET 4400 - Simulation Methods
Introductory course in computer simulation designed to model processes found in the manufacturing or service environment. Computer software will be used to model real life problems, analyze alternative solutions and generate recommendations. Projects involving local manufacturing and service situations will be modeled.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Spring - Offered alternate years beginning with the 2009-2010 academic year
Pre-Requisite(s): MA 2710 or MA 2720 or MA 3710

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 4500 - Lean Manufacturing, Principles, Concepts and Applications
Provides an understanding of current concepts required to implement lean manufacturing in various manufacturing and service sectors. Focus is on the essentials required to provide products and services that meet customer demand with reduced lead times, elimination of waste and safety improvements.
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

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: Fall - Offered alternate years beginning with the 2010-2012 academic year
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): MEEM 2500 and MET 2400

MET 4660 - Applied Finite Element Analysis
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 - 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): 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, Summer - Offered alternate years beginning with the 2008-2009 academic year
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): MEEM 2500

MET 4900 - Alternative Energy Systems
Presents an overview of world energy resources and energy consumption trends. Conventional and emerging energy sources and conversion methods are discussed in terms of their long term viability, based on technical and political factors.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
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): MET 3600

MET 4996 - 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 project/program.
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 CMfgT (Certified Manufacturing Technologist) exam.
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): Senior

Materials Science & Engrg

MY 2000 - Introduction to Materials Processing
Introduction to the science and technology of the production of primary and engineering materials. Topics include mineral processing, extractive metallurgy, casting, deformation processing, powder fabrication, thin film deposition, joining and machining. Demonstrations and laboratory exercises will be employed to highlight these processing techniques.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Spring
Pre-Requisite(s): ENG 1101 or ENG 1100

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, Summer
Pre-Requisite(s): CH 1100 or CH 1110 or CH 1112 or CH 1120 or CH 1122 or (CH 1150 and CH 1151) or (CH 1160 and CH 1161)

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

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 3100

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
Pre-Requisite(s): MY 2100

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: 4.0
Lec-Rec-Lab: (2-1-3)
Semesters Offered: Spring
Pre-Requisite(s): MY 2100

MY 3292 – Control of Light in 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 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 3100 and MY 3200

MY 3400 - Mechanical Properties of Materials
An introduction to the deformation and fracture behavior of metals, ceramics, polymers, and composites. Topics include yielding criterion, plastic deformation, strain hardening, strengthening mechanisms, viscoelasticity, fatigue, fracture, and microstructure/mechanical property relationships.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Pre-Requisite(s): MY 2100 and (MEEM 2150 or ENG 2120)

MY 3700 - Electronic, Optical, and Magnetic Properties of Materials
Provides background needed to understand how electrons and electromagnetic waves interact with materials. Topics include waves, bonding, phonons, bands, the basics of semiconducting, metallic, dielectric, optical, and magnetic material properties, and how elementary devices made from these materials operate.
Credits: 4.0
Lec-Rec-Lab: (3-1-0)
Semesters Offered: Spring
Pre-Requisite(s): (PH 2200 or PH 2260) and MA 3160 and (MA 3520 or MA 3521 or MA 3530)

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: Spring
Pre-Requisite(s): MY 2100

MY 4180 - Science and Engineering of Structural Metals
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
Restrictions: May not be enrolled in one of the following Class(es): freshman, sophomore

MY 4201 - Practical Scanning Electron Microscopy
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
Pre-Requisite(s): MY 4200(C)

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 4240D - 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 4410 - Metal Forming
Introduction to metal forming, including rolling, forging, extrusion, drawing, stamping, and sheet metal forming. Covers practical aspects of manufacturing processes, as well as continuum-mechanical and finite element modeling of deformation during working, and metallurgical aspects of forming processes and resulting products.
Credits: 2.0
Lec-Rec-Lab: (2-0-0)
Semesters Offered: On Demand
Pre-Requisite(s): MY 3400 or MEEM 2150

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: On Demand
Pre-Requisite(s): MY 2100

MY 4740 - Hydrometallurgy/Pyrometallurgy
Extracting metal from ores by aqueous chemical techniques. The unit processes and unit operations in the dissolution, solubility, aqueous chemistry, concentrating and purifying metal-bearing solutions, and recovery of metals by precipitation and electrolytic processing will be discussed.
Credits: 4.0
Lec-Rec-Lab: (4-0-0)
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, sophomore
Pre-Requisite(s): CH 1120 or CH 1122 or (CH 1160 and CH 1161)

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 4900 - Materials Science and Engineering Professional Development
Engineering ethics, professional registration, industrial safety and hygiene, intellectual property, professional development and communication skills in the context of Capstone Senior Design and professional employment.
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, junior
Pre-Requisite(s): MY 3110 and MY 3200 and MY 3210 and MY 3300 and MY 3400

MY 4901 - Materials Science and Engineering Senior Design Project I
Conducted in teams of students working with an industrial partner. 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
Restrictions: May not be enrolled in one of the following Class(es): freshman, sophomore, junior
Pre-Requisite(s): MY 4900

MY 4910 - Materials Science and Engineering Senior Design Project II
Capstone senior design project, conducted in teams of students working on a problem with an industrial partner. Open to all engineering majors interested in interdisciplinary projects. (Senior project ready as defined by major substitutes for prerequisites)
Credits: 3.0
Lec-Rec-Lab: (0-1-6)
Semesters Offered: Spring
Restrictions: May not be enrolled in one of the following Class(es): freshman, sophomore, junior
Pre-Requisite(s): MY 4901

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

MY 5100 - Thermodynamics and Kinetics I
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Level(s): Graduate
The kinetics of liquid-to-solid and solid-to-solid phase transformations. Diffusion-controlled phase transformations, including nucleation, growth, coarsening, spinodal decomposition, eutectic and eutectoid transformations, cellular transformations, and massive transformations. Martensitic transformations.

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): MY 5100

MY 5200 - Advanced Scanning Electron Microscopy
Basic design and operating principles of scanning electron microscope (SEM) with discussions on interactions of electrons with solids and resulting signal production, for analysis of heterogeneous materials using X-ray microanalysis, and applications to surface science. Includes practical training on advanced operation of SEM and FE-SEM (FE=field emission) instruments with an emphasis on the production of high resolution images and quantitative X-ray analysis of specimen composition based on real and virtual standards. (*if available)
Credits: 3.0
Lec-Rec-Lab: (2-0-3)
Semesters Offered: Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate Pre-Requisite(s): MY 5100

MY 5250 - Transmission Electron Microscopy
Practical aspects of materials characterization by transmission electron microscopy.
Credits: 3.0
Lec-Rec-Lab: (2-0-3)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate Pre-Requisite(s): MY 5100

MY 5260 - Crystallography & Diffraction
Crystallographic concepts and diffraction analyses in materials science.
Credits: 3.0
Lec-Rec-Lab: (2-0-3)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate Pre-Requisite(s): MY 5100

MY 5410 - Materials for Energy Applications
Advanced solid materials for hydrogen energy will be introduced, including hydrogen storage materials, hydrogen production catalysts, and proton exchange membranes with emphasis on structures and properties. Silicon semiconductors, compound semiconductors, and nanocrystalline semiconductors will be discussed for solar energy applications.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate Pre-Requisite(s): MY 5100

MY 5430 - Electronic Materials
A study of the physical principles, operational characteristics, models, and basic applications of selected solid-state devices.
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): MY 5100

MY 5460 - Solid State Devices
A study of the physical principles, operational characteristics and models and basic applications of solid state devices such as p-n junctions, metal-semiconductor junctions and transistors.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Level(s): Graduate Pre-Requisite(s): MY 5100

MY 5470 - Semiconductor Fabrication
Graduate level introduction to the science and engineering of semiconductor device fabrication.
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): MY 5100

MY 5480 - Advanced MEMS
This course will cover advanced topics dealing with MEMS technologies, transduction mechanisms, and microfabricated sensors and actuators and is continuation of EE4240/MY4240.
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, Junior Pre-Requisite(s): EE 4240 or MY 4240

MY 5480D - Advanced MEMS
This course will cover advanced topics dealing with MEMS technologies, transduction mechanisms, and microfabricated sensors and actuators and is continuation of EE4240/MY4240.
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, Junior Pre-Requisite(s): MY 4240D or EE 4240D

MY 5550 - Solid Surfaces
The performance, durability, and stability of composites, coatings, films, advanced ceramics, implants, and nano-technological products rely on the understanding, control and manipulation of surfaces and interfaces. This course provides both a fundamental and practical introduction to the concepts and theories of solid surfaces and solid-liquid interfaces. The capillary effects, electrical aspects of interfaces, and adsorption at materials surfaces, with their practical applications and consequences, are emphasized.
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): MY 5100

MY 5580 - Introduction to Scanning Probe Microscopy
Students will learn basics of design and fundamental physics behind the scanning probe microscopy techniques. The lectures will also discuss analysis of the solid surfaces regarding roughness, topography, composition, heterogeneity, and adhesion properties using atomic force microscopy (AFM). Artifacts associated with inappropriate conditions in atomic AFM imaging will be discussed as well. Training in the operation of the AFM instrument and exploration of its capability during the laboratory sessions will complement the lectures.
Credits: 2.0
Lec-Rec-Lab: (1-0-3)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Level(s): Graduate Pre-Requisite(s): MY 5100

MY 5600 - Powder Processing
Processing of metal and ceramic powders into bulk products. Powder manufacture and characterization, compaction, sintering, pressure-assisted consolidation to full density. Emphasis on principles underlying consolidation practices.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: On Demand - Offered alternate years beginning with the 2005-2006 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior Pre-Requisite(s): MY 2100

MY 5610 - Materials Recycling: Processing and Utilization
Methods for materials recycling is the emphasis. Topics include the recycling of materials for steel, aluminum, automobile, foundry, glass, plastics, energy, construction, and other industries. Background of the industry, characteristics of materials, materials flow, and the processing and utilization methods to recycle the materials are presented.
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 Pre-Requisite(s): MY 2100

MY 5900 - Graduate Seminar
Graduate student presentations at departmental seminars.
Credits: 1.0; May be repeated
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate Pre-Requisite(s): MY 5000

MY 5970 - Special Topics - Graduate Materials Science and Engineering
Special Topics in Materials Science and Engineering at the Graduate level.
Credits: variable to 4.0; Repeatable to a Max of 8
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate Pre-Requisite(s): MY 5000

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MY 5975 - Full Time Master’s Research
Open to students who have successfully completed all the required courses as well as the required number of credits for the master’s degree. Students in this course are involved in full-time research. Tuition for this course is charged at the graduate full-time research rate. Students enrolled in this course may not register for any other course.
Credits: 9.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-9-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

MY 5990 - MS Thesis Research
Fundamental and applied research in metallurgical and materials engineering. Taken by graduate students in partial fulfillment of the MS thesis requirements.
Credits: variable to 12.0; May be repeated; Graded Pass/Fail Only
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate

MY 6100 - Computational Materials Science and Engineering
Computational and analytical techniques applied to materials science and engineering problems. Develops student facility with modern computational techniques.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

MY 6110 - Advanced Topics in Materials Processing
Advanced treatment of various unit operations of materials processing. Operations may include deformation processing, powder and particulate technology, solidification processing, thermomechanical processing, optimum process selection, etc.
Credits: variable to 4.0; May be repeated
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

MY 6200 - Advanced Topics in Materials Characterization
Advanced concepts in materials characterization. Specific course content is tailored to meet the interests of the students and faculty.
Credits: variable to 4.0; May be repeated
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

MY 6400 - Advanced Topics in Mechanical Behavior of Materials
Advanced concepts in mechanical behavior of materials. Specific course content is tailored to meet the interests of the students and faculty.
Credits: variable to 4.0; May be repeated
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

MY 6480 - Thin Films
Material Science of thin films.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Level(s): Graduate

MY 6975 - Full-Time Doctoral Research
Open to students who have successfully completed all required courses as well as the comprehensive and proposal defense exams. Students in this course are involved in full-time research. Tuition for this course is charged at the graduate full-time research rate. Students enrolled in this course may not register for any other course.
Credits: 9.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-9-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

MY 6990 - PhD Thesis Research
Fundamental and applied research in metallurgical and materials engineering. Taken by graduate students in partial fulfillment of the PhD thesis requirements.
Credits: variable to 12.0; May be repeated; Graded Pass/Fail Only
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate

Physical Education
PE 0102 - Orienteering
"Hands on" course teaches basic principles of orienteering including map reading emphasizing terrain association/relativity, map margin information, topographic symbology, and determining location using intersection and resection techniques. 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 0103 - Bait and Fly Casting
Bait and fly casting skills. Each student must have a valid current Michigan fishing license. Trout stamp is optional. Equipment is available if needed. Requires some additional hours outside of class. 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 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: Fall, Spring, Summer

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: Fall, 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 officials. 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 sweat suits (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 0113 - 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, 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: Fall, Spring, Summer

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: Fall, Spring

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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 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 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 should 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, Spring

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. Rentals are not available.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Spring

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: Fall, Summer

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, Spring

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: Fall, Spring

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, Spring

PE 0132 - Beginning Social Dance
Introduction to a variety of dance steps, such as the jitterbug/swing, polka, country 2 step, tango, waltz, foxtrot, and slow dance. 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 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 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 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 0142 - 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 0148 - Beginning Skating
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, Spring

PE 0150 - Lifetime Activities
This class will introduce students to a variety of recreational activities often used in a social/leisure setting (i.e. shuffleboard). 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 0152 - Beginning Social Dance
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 0153 - Beginning Aerobics
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
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, Summer
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, Summer

PE 0156 - Rowing
Students will learn the anatomy and technique of rowing. Students will be given workouts they can use outside of class to improve their technique and fitness levels. Workouts during class will vary accordingly with class ability levels. Students will participate in facility challenges.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring

PE 0166 - Moving for Fitness
Basic movement at your own level. Requires own equipment for some activities. Some examples of activities are running, walking, rollerblading, biking, and group activities. 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 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. Course is taught at the Aspirus Keweenaw Rehab & Fitness Center on Sharon Avenue.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring

PE 0170 - Beginning Tae Kwon Do and Hapkido
Introduction to the basic kicking, blocking, punching, joint locking, and throwing techniques of Tae Kwon Do 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 0173 - Fall Outdoor Adventures
Outdoor seasonal activities; may involve hiking, camping, fishing, orienteering, etc. Class is instructed by members of the Outdoor Ventures Crew. 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 0174 - Winter Outdoor Adventures
Outdoor seasonal activities; may involve fishing, camping, skiing, orienteering, etc. Class is instructed by the Outdoor Ventures Crew. 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: Winter

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 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 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, Summer

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, Spring

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, Summer

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: Fall, Spring

PE 0228 - Intermediate Billiards
Intermediate to advanced skills 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 0229 - Intermediate Aqua Volleyball
Continuation of beginning social dance. 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 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

PE 0233 - Intermediate Cross Country Skiing
Development of touring, recreational, and racing skills in cross country skiing. Own equipment is recommended; rental equipment available. Basic skills evaluating 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 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 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 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, Summer
Pre-Requisite(s): PE 0140

PE 0246 - Intermediate Billiards
Intermediate to advanced skills 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 - Intermediate Social Dance
Continuation of beginning social dance. 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, Spring

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, Summer

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, Summer

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 - Intermediate Tae Kwon Do and Hapkido
Intermediate to advanced techniques, skills, and strategies involved in Tae Kwon Do. 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 0301 - Military Marksmanship
Develops marksmanship skills through individual practice and competition among individuals and record fire for qualification. Emphasizes awareness of firearm safety and leadership responsibility through marksmanship training. May be used once as a general education co-curricular course. Credits: 1.0; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring
PE 0306 - Advanced Golf
Learn different types of tournaments. Compete with advanced players and
learn proper etiquette in tournament competition. Add to skills in this great
lifelong sport. 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 0315 - Fitness Swimming
Practices the basic strokes; introduces knowledge in creating workouts to
courage 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: Fall, 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 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: Fall, 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, Summer
Restrictions: Permission of department required

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 SnoSports Education Association, if they choose.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Spring

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 SnoSports Education Association, if they choose.
Credits: 0.5; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: On Demand

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 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; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-5)
Semesters Offered: Fall

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; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-5)
Semesters Offered: Fall, Spring

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; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-5)
Semesters Offered: Fall, Spring

PE 2040 - Varsity Nordic Skiing
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; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-5)
Semesters Offered: Spring

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; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-5)
Semesters Offered: Fall, Spring

PE 2090 - Varsity Tennis
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; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-5)
Semesters Offered: Fall, Spring

PE 2130 - Varsity Volleyball
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; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-5)
Semesters Offered: Fall

PE 2140 - Varsity Cross Country
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; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-5)
Semesters Offered: Fall

PE 2150 - Cross Training
A broad base understanding of sports cross training and activities that can be
pursued as lifelong activities. May be used once as a general education co-
curricular course.
Credits: 1.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-5)
Semesters Offered: Fall, Spring

PE 2230 - Cheerleading Dance Team
A dance squad that attends set class practices and participates in athletic
contests. A varsity letter is earned by those who fulfill the requirements. May
be used once as a general education co-curricular credit.
Credits: 1.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-5)
Semesters Offered: Fall, Spring

Undergraduate Course Descriptions, 2009-10, Page 111 of 132
PH 0010 - Development of Physics Skills
Individualized instruction in physics problem solving and general study skills from professional physics coaches. Benefits students looking for help with demanding introductory physics courses (PH1110, PH1210, PH2100, PH2200). Credits do not count toward graduation.
Credits: 0.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-5)
Semesters Offered: Fall, Spring
Restrictions: Permission of instructor required

PH 0200 - Team Approach to Learning Physics
Students meet 2 hours/week with 4 to 6 team members taking the same introductory physics course. Students work with a professional physics coach to learn the team approach to physics problem solving. Benefits students looking for help with demanding courses who desire experience in team problem solving. Credits do not count toward graduation.
Credits: 0.0; May be repeated
Semesters Offered: Fall, Spring
Restrictions: Permission of instructor required

PH 0991 - 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
Co-Requisite(s): PH 1090

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
Co-Requisite(s): PH 1090

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, 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
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 College(s): School of Technology
Co-Requisite(s): PH 1141
Pre-Requisite(s): MA 1031 or MA 1032 or MA 1160(C) or MA 1161(C)

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 College(s): School of Technology
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.
Pre-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.
Pre-Requisite(s): PH 1140

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, Applied Physics
Co-Requisite(s): PH 1160
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, 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

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
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 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
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
<th>Credits</th>
<th>Semesters Offered</th>
<th>Co-Requisite(s)</th>
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<th>Remarks</th>
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</thead>
<tbody>
<tr>
<td>PH 1360 - Honors Physics II - Rotation and Vibration</td>
<td>Continuation of PH 1160. Topics include rotational motion, simple harmonic motion and mechanical waves. Offered first half of spring semester.</td>
<td>2.0</td>
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<td>PH 1361 - Introductory Experimental Physics II</td>
<td>Laboratory complement to PH 1360. Waves, thermodynamics, and electrostatics are explored through guided construction. The course emphasizes understanding physical concepts through inquiry and the scientific method.</td>
<td>2.0</td>
<td>Fall</td>
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<td>Semesters Offered: Spring</td>
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<td>PH 1600 - Introductory Astronomy</td>
<td>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.</td>
<td>2.0</td>
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<td>Semesters Offered: Fall, Spring, Summer</td>
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<tr>
<td>PH 1610 - Introductory Astronomy Lab</td>
<td>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.</td>
<td>1.0</td>
<td>Fall</td>
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<td>(0-0-2)</td>
<td>Semesters Offered: Fall</td>
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<td>Pre-Requisite(s):</td>
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<td>PH 1600</td>
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<td>Lec-Rec-Lab:</td>
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<tr>
<td>PH 2010 - Sophomore Seminar</td>
<td>Discussion of recent research and developments in physics.</td>
<td>1.0</td>
<td>Fall</td>
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<td>(0-1-0)</td>
<td>Semesters Offered: Fall</td>
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<td>Restrictions:</td>
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<td>May not be enrolled in one of the following Class(es): Freshman</td>
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<td>PH 2100 - University Physics I-Mechanics</td>
<td>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.</td>
<td>3.0</td>
<td>Fall</td>
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<td>(3-0-0)</td>
<td>Semesters Offered: Fall, Spring, Summer</td>
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<td>Pre-Requisite(s):</td>
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<td>PH 1100(C) and (MA 1160 or MA 1161) and MA 2160(C)</td>
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<td>PH 2200 - University Physics II-Electricity and Magnetism</td>
<td>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.</td>
<td>3.0</td>
<td>Fall</td>
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<td>(3-0-0)</td>
<td>Semesters Offered: Fall, Spring, Summer</td>
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<td>Pre-Requisite(s):</td>
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<td>PH 2100 and (MA 3520 or MA 3521 or MA 3530 or MA 3560)</td>
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<td>PH 2230 - Electronics for Scientists</td>
<td>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.</td>
<td>4.0</td>
<td>Fall</td>
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<td>(3-0-3)</td>
<td>Semesters Offered: Fall</td>
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<td>Restrictions:</td>
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<td>May not be enrolled in one of the following Major(s): Electrical Engineering, Computer Engineering</td>
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<td>Pre-Requisite(s):</td>
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<td>PH 2200 or PH 2260</td>
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<tr>
<td>PH 2260 - Honors Physics III - Electricity and Magnetism</td>
<td>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.</td>
<td>4.0</td>
<td>Fall</td>
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<td>(4-0-0)</td>
<td>Semesters Offered: Fall</td>
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<td>Pre-Requisite(s):</td>
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<td></td>
<td>(PH 1160 or PH 2100) and (PH 1200(C) or PH 2261(C)) and MA 2160</td>
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<td>Lec-Rec-Lab:</td>
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PH 3410 - 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 3411 - 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

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
Pre-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 4080
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.
Credits: 1.0
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
Co-Requisite(s): PH 4010
Pre-Requisite(s): PH 3480

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)
Semesters Offered: Fall
Pre-Requisite(s): (PH 2200 or PH 2260) and PH 3110 and (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)
Semesters Offered: Spring
Pre-Requisite(s): PH 4210

PH 4380 - Computers in the Physics Lab
How computers are used for data acquisition, data treatment and analysis, graphics display, and controlling experiments. Develops skills necessary to interface and automate instruments and systems.
Credits: 2.0
Lec-Rec-Lab: (0-0-5)
Semesters Offered: Fall
Pre-Requisite(s): PH 2200 or PH 2260

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: (1-0-4)
Semesters Offered: On Demand
Pre-Requisite(s): PH 3300 and PH 4390 and (PH 2400 or PH 3410)

PH 4395 - Computer Simulation 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: 2.0
Lec-Rec-Lab: (2-0-0)
Semesters Offered: Fall
Pre-Requisite(s): PH 3410

PH 4510 - Introduction to Solid State Physics
Crystal structures, X-ray diffraction, phonons, free electron theory of metals, rudiments of band theory, an overview of semiconductors, and other topics in solid-state physics.
Credits: 2.0
Lec-Rec-Lab: (2-0-0)
Semesters Offered: Fall
Pre-Requisite(s): (PH 2300 or PH 1360) and PH 3400 and (CH 1150 and CH 1151) and (MA 3520 or MA 3521 or MA 3530 or MA 3560)

PH 4610 - Stellar Astrophysics
Topics include an overview of observational astrophysics, stellar atmospheres, stellar structure, atomic properties of matter, radiation and energy transport in stellar interiors, and stellar evolution to and from the main sequence. Course offered every third year beginning 2008-09.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2008-2009 academic year
Pre-Requisite(s): PH 1600 and PH 2400 and (MA 3520 or MA 3521 or MA 3530 or MA 3560)

PH 4620 - Galactic 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 2009-10.
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): PH 1600 and PH 2400 and (MA 3520 or MA 3521 or MA 3530 or MA 3560)
PH 4630 - Particle Astrophysics
Introduces to the twin fields of elementary particle physics and high energy astrophysics. Topics include an overview of particles and interactions, the expanding universe, conservation laws, dark matter and dark energy, large scale structure, and cosmic particles. Course offered every third year beginning 2007-08.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2007-2008 academic year
Pre-Requisite(s): PH 2400 and (MA 3520 or MA 3521 or MA 3530 or MA 3560)

PH 4640 - Introduction to Atmospheric Physics
Essential elements of atmospheric physics, including thermodynamics (adiabatic processes, phase transformations, stratification), aerosol and cloud physics (e.g. nucleation, Kohler theory, growth by condensation and collection), radiative transfer (e.g. Beer's law, transfer equations with and without scattering).
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): (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 4999 - Special Topics in Physics
Selected additional topics in physics for advanced students based on interests of faculty and students. Interested students should contact the physics department.
Credits: variable to 9.0; May be repeated
Semesters Offered: Fall, Spring, Summer

PH 5010 - Graduate Journal Club
Presentation and discussion of current issues in physics and recent research by departmental faculty and others. One credit in journal club is required for all graduate degrees in physics.
Credits: 1.0
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate

PH 5090 - Special Topics in Physics
The subject matter may vary from term to term and year to year depending on the needs of advanced students.
Credits: variable to 3.0; May be repeated
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate

PH 5110 - Classical Mechanics
Lagrangian methods, symmetries and conservation laws, variational formulation, small oscillations, Hamilton's equations, contact transformations, Poisson brackets, Hamilton-Jacobi theory, Lorentz-invariant formulation.
Credits: 2.0
Lec-Rec-Lab: (2-0-0)
Semesters Offered: Fall, Spring - Offered alternate years beginning with the 2002-2003 academic year
Restrictions: Must be enrolled in one of the following Level(s): Graduate

PH 5210 - Electrodynamics I
Electrostatics and magnetostatics, boundary value problems, multipoles, Maxwell's equations, time-dependent fields, propagating wave solutions, radiation.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): PH 5320

PH 5211 - Electrodynamics II
Scattering and diffraction, special relativity, relativistic particle dynamics, Lorentz transformation, 4-vectors, transformation of fields, charges and currents, Thomas precession, retarded potentials, radiation from moving charges.
Credits: 2.0
Lec-Rec-Lab: (2-0-0)
Semesters Offered: On Demand - Offered alternate years beginning with the 2008-2009 academic year
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): PH 5210

PH 5310 - Statistical Mechanics
Ensembles, partition functions and distributions, thermodynamic potentials, quantum statistics, ideal and nonideal gases, interacting systems. Applications may include classical and quantum liquids, phase transitions and critical phenomena, correlation functions, linear response and transport theory, or other topics.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2007-2008 academic year
Restrictions: Must be enrolled in one of the following Level(s): Graduate

PH 5320 - Mathematical Physics
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Level(s): Graduate

PH 5410 - Quantum Mechanics I
Study of the postulates of quantum mechanics framed in Dirac notation, the Heisenberg uncertainty relations, simple problems in one dimension, the harmonic oscillator, the principles of quantum dynamics, rotational invariance and angular momentum, spherically symmetric potentials including the hydrogen atom, and spin.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Level(s): Graduate

PH 5411 - Quantum Mechanics II
Continuation of PH5410. Includes the study of symmetries and their consequences, the variational method, identical particles, the Hartree-Fock approximation time-independent perturbation theory, time-dependent perturbation theory, diatomic molecules with applications to H2+, many-body perturbation theory, and the Dirac equation.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): PH 5410

PH 5510 - Theory of Solids
Free electron theory, Bloch's theorem, electronic band structure theory, Fermi surfaces, electron transport in metals and semiconductors. Lattice vibrations and phonons, other topics as time permits.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2000-2001 academic year
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): PH 5520 and PH 5410

PH 5520 - Materials Physics
Materials classification and structures; phase diagrams; lattice imperfections; quasicrystals; boundaries and interfaces; mechanical, electronic, optical, magnetic and superconducting properties of materials.
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, Junior

PH 5530 - Selected Topics in Nanoscale Science and Technology
Presentation and discussion of selected topics in nanoscale science and engineering. Topics include growth, properties, applications, and societal implications of nanoscale materials. Evaluation: attendance and assignment.
Credits: 2.0
Lec-Rec-Lab: (2-0-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

PH 5610 - High Energy Astrophysics
An introduction to the ideas and results of astrophysics and high energy physics.
Credits: 2.0
Lec-Rec-Lab: (2-0-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): PH 2300 and (MA 3520 or MA 3521 or MA 3530 or MA 3560)

PH 5640 - Atmospheric Physics
Essential elements of atmospheric physics, including thermodynamics (e.g. adiabatic processes, phase transformations, stratification), aerosol and cloud physics (e.g. nucleation, Kohler theory, growth by condensation and collection), and radiative transfer (e.g. Beer's law, transfer equations with and without scattering).
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2008-2009 academic year
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): PH 2300 and (MA 3520 or MA 3521 or MA 3530 or MA 3560)
PH 5680 - Atmospheric Fluid Dynamics
Fundamental forces and conservation laws that govern fluid flow; applications to the atmosphere, including balanced flow (pressure gradient and Coriolis force), vorticity dynamics, turbulence, waves, and boundary layers.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2007-2008 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior
Pre-Requisite(s): PH 2300 and (MA 3520 or MA 3521 or MA 3530 or MA 3560)

PH 5975 - Full Time Master's Research
Open to students who have successfully completed all the required courses as well as the required number of credits for the master's degree. Students in this course are involved in full-time research. Tuition for this course is charged at the graduate full-time research rate. Students enrolled in this course may not register for any other course.
Credits: 9.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-9-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

PH 5999 - Master's Research
Master's-level research conducted under the direction of a graduate faculty advisor.
Credits: variable to 12.0; May be repeated; Graded Pass/Fail Only
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor and department required; Must be enrolled in one of the following Level(s): Graduate

PH 6975 - Full-Time Doctoral Research
Open to students who have successfully completed all required courses as well as the comprehensive and proposal defense exams. Students in this course are involved in full-time research. Tuition for this course is charged at the graduate full-time research rate. Students enrolled in this course may not register for any other course.
Credits: 9.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-9-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

PH 6999 - Doctoral Research
Independent research conducted in partial fulfillment of the requirements for the PhD degree. Scheduled by arrangement.
Credits: variable to 12.0; May be repeated; Graded Pass/Fail Only
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor and department required; Must be enrolled in one of the following Level(s): Graduate

Psychology

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: (3-0-0)
Semesters Offered: Fall, Spring, Summer

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)
Semesters Offered: Spring, Summer
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)
Semesters Offered: Fall
Pre-Requisite(s): PSY 2000

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)
Semesters Offered: Spring, Summer
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)
Semesters Offered: Spring - Offered alternate years beginning with the 2008-2009 academic year
Pre-Requisite(s): PSY 2000

PSY 2501 - Intro to the Psychology Major: Tools and Technology
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. An introduction to the technological tools used within psychology, including hardware, software, and instrumentation.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
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: On Demand
Pre-Requisite(s): PSY 2000

PSY 2700 - Statistics for the Social and 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: (0-4-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Major(s): Social Sciences, Liberal Arts with History Opt, Psychology
Pre-Requisite(s): MA 1020 or MA 1031 or MA 1032

PSY 2720 - Statistics for the Social and 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: (0-4-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Major(s): Social Sciences, Liberal Arts with History Opt, Psychology
Pre-Requisite(s): MA 1020 or MA 1031 or MA 1032

PSY 3000 - Experimental 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
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: Fall, Spring
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
Pre-Requisite(s): PSY 2000
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
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requirement(s): PSY 2000

PSY 3040 - History/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: On Demand
Pre-Requirement(s): PSY 2000

PSY 3060 - Physiological Psychology
Introduces the physiological systems that underlie behavior with emphasis on the nervous system, neurotransmission, sensory systems, psychopharmacology, and research methods unique to the field of physiological psychology.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requirement(s): PSY 2000 and (BL 1020 or BL 1040 or BL 2010 or BL 2400)

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: On Demand
Pre-Requirement(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-Requirement(s): PSY 2000

PSY 3095 - Teaching Assistant
Undergraduate Teaching Assistant for Principles of Psychology or other Psych 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; May not be enrolled in one of the following Class(es): Freshman
Pre-Requirement(s): PSY 2000

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: Spring - Offered alternate years beginning with the 2008-2009 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requirement(s): PSY 2000

PSY 3500 - Human Robot Interaction
An overview of the physical, cognitive, and performance capabilities and limitations of humans as they interact with robots and other artificial agents. Emphasis is placed on the tools, techniques and procedures for the assessment and effective design of collaborative human-robot work environments.
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-Requirement(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: Spring - Offered alternate years beginning with the 2008-2009 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requirement(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 - Offered alternate years beginning with the 2009-2010 academic year
Pre-Requirement(s): UN 2002 or PSY 2000

PSY 3800 - Environmental Psychology
Psychological effects of the physical environment and effects of human action on the sociophysical environment, including an examination of global environmental issues and ecologically-relevant 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-Requirement(s): PSY 2000

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 - Offered alternate years beginning with the 2008-2009 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requirement(s): PSY 2000

PSY 3860 - Human Performance
Study of human performance including acquisition and retention of skills, performance in typical and highly demanding environments and methods of improving performance.
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-Requirement(s): PSY 2000

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
Pre-Requirement(s): PSY 2000

PSY 4060 - Behavioral Neuroscience
Topics in the field of behavioral neuroscience, intended as the sequel to PSY3060 - Physiological Psychology. Topics may include motor and sensory systems and complex motivated behaviors such as sleep, reproduction, and eating.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2009-2010 academic year
Pre-Requirement(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-Requirement(s): PSY 2000

PSY 4090 - Independent Study in Psychology
Designed to allow students to participate in independent readings and research in a variety of areas within psychology.
Credits: variable to 3.0; 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): Psychology; May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requirement(s): PSY 2000 and PSY 3000(C)
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
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, Sophomore
Pre-Requisite(s): PSY 2000 and PSY 2500

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: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): PSY 2000

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: Fall
Pre-Requisite(s): PSY 2060

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: 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): 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 career preparation or application to graduate programs, an intensive exploration into an aspect (e.g., teaching, service, research) and area (e.g., experimental, developmental, clinical) of psychology will enhance learning and unify knowledge and experiences acquired as a psychology major.

Credits: 2.0
Lec-Rec-Lab: (0-2-0)
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 and PSY 3001(C)

PSY 5010 - 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: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): PSY 2000

PSY 5060 - Behavioral Neuroscience
Advanced topics in the field of behavioral neuroscience and neuroergonomics. Topics may include motor and sensory systems and complex motivated behaviors such as vigilance, attention, adaptive automation, and fatigue countermeasures.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

PSY 5100 - Applied Cognitive Science
Survey of applied human information processing literature, detailed review of recent developments in applied cognitive science, and examination of the purposes, role and scope of cognitive engineering.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

PSY 5160 - 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: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): PSY 3060

PSY 5210 - Advanced Statistical Analysis and Design I
An overview of research ethics, experimental design, proposal writing, and univariate statistics such as t-tests and ANOVA.

Credits: 4.0
Lec-Rec-Lab: (0-4-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

PSY 5220 - Advanced Statistical Analysis and Design II
A continuation of PSY 5210 covering multivariate and nonparametric statistics such as MANOVA, ANCOVA, Multiple Regression, faction analysis, and Chi Square.

Credits: 4.0
Lec-Rec-Lab: (0-4-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): PSY 5110

PSY 5300 - Human Performance
An overview of factors contributing to human performance in human-machine systems. Topics include cognitive workload, attention, fatigue, aging, stress, and perceptual limitations.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

PSY 5400 - Ergonomics and Biomechanics
An overview of the physical aspects of user-centered design. Specific topics include anthropometry, repetitive strain injuries, and physical workload evaluation.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

PSY 5500 - Supervised Teaching Practicum
An experiential course in which student gain practical experience with course design and instruction.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

PSY 5610 - Automation
An overview of the changing role of human users in automated systems. Topics include levels of automation, automation trust issues, automation uses and misuses, and the role of automation in human performance.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

PSY 5850 - Human Factors Psychology
Advanced concepts critical to the design of human-technological systems, such as capitalizing upon human capabilities and compensating for human limitations. Topics may include perceptual and motor abilities, human error and cognitive engineering.

Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate
PSY 5860 - Human Factors II
An overview of the tools and techniques used by human factors researchers and practitioners. Topics include task analysis, link analysis, human error in systems, workload analysis, and physiological assessment techniques.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): PSY 5850

PSY 5880 - Current Issues in Human Factors
An overview of the state of the field of human factors, trends, ethics for human factors practitioners, and career development.
Credits: variable to 3.0; Repeatable to a Max of 6
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): PSY 5860

PSY 5900 - Graduate Research Project
Proposal and data collection phases of an independent research project.
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 Level(s): Graduate

PSY 5910 - Independent Research
Completion of research project.
Credits: 3.0; Repeatable to a Max of 21
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): PSY 5100

PSY 6990 - Special Topics in Cognitive Science
Study of special topics in cognitive science as designed by section title.
Credits: 3.0; Repeatable to a Max of 6; Graded Pass/Fail Only
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): PSY 5100

PSY 6991 - Special Topics in Human Factors
Study of special topics in human factors as designed by section title.
Credits: 3.0; Repeatable to a Max of 6
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): PSY 5860

PSY 6999 - Dissertation Research
Fundamental and applied research in cognitive science and human factors psychology.
Credits: variable to 6.0; Repeatable to a Max of 10; Graded Pass/Fail Only
Semesters Offered: On Demand
Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

Sciences and Arts

SA 1000 - Sciences and Arts Explorations
Exploration of majors and related career opportunities. Includes an introduction to University resources such as the Career Center, presentations by experts, 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
Restrictions: Must be enrolled in one of the following Major(s): General Sciences and Arts

Systems Admin. Technology

SAT 1200 - Introduction to Programming
Introductory course in 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 OS 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 portfolio.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Major(s): Computer Network & System Admin
Pre-Requisite(s): SAT 1200

SAT 1700 - Computer-Cyber Ethics/Policy
Ethical, privacy, liability, and regulatory compliance issues in managing computer and network administrations. Other topics include the digital ID debate, biometrics, computer use policy, privacy statements, P3P, security policy, FCC mandates, state utility commission mandates, W3C, standards development bodies.
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, administration UNIX and NT systems running TCP/IP, 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
Pre-Requisite(s): SAT 1610

SAT 2511 - MS System Administration I
Microsoft server software installation and configuration. Development of system interface scripts to perform tasks specific to client/server applications. Other topics include RDP, directory services, device drivers, SLIP/PPP, and SAN/NAS access.
Credits: 4.0
Lec-Rec-Lab: (0-3-2)
Semesters Offered: Spring
Pre-Requisite(s): SAT 2343

SAT 2711 - Unix & Linux Administration I
Study of networked systems in Linux and UNIX. Topics include Linux file system administration, Bash shell, system initialization and X windows, Linux processes management, print and log administration, compression, system back up/restore, network services (FTP, NFS, Samba) and security (firewall) configuration.
Credits: 4.0
Lec-Rec-Lab: (0-3-3)
Semesters Offered: Fall, Summer
Pre-Requisite(s): SAT 1200

SAT 3200 - Storage Area Networking
Study of distributed network storage methods, that is iSCSI, NAS, SAN, and SAN technologies. Other topics include storage and computer virtualization, configuration management, storage farms, backup and recovery.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Fall
Pre-Requisite(s): SAT 2511 and SAT 2711

SAT 3210 - Database Management
Introductory course on database management. Topics include the essential concepts, principles, and techniques of modern database systems.
Administration of latest RDBMS, such as Oracle and SQ2 language.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Fall, Summer
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, Summer
Pre-Requisite(s): SAT 2343
SAT 3511 - MS System Administration II
Advanced MS administration functions. Topics include TCP/IP infrastructures, managing storage, grid and clustered computing, configuring print servers, Windows terminal server, MS system tuning, remote access, and back up and recovery from failures.

Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Fall
Pre-Requisite(s): SAT 2511

SAT 3711 - Unix & Linux Administration II
Advanced study of UNIX and Linux OS. Topics include security architecture, attack methods and counter-measures, patch management, performance monitoring, security management tools, best practices, policy management, virus scanning, security protocols, intrusion detection, firewalls, and SSL/TLS.

Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Spring, Summer
Pre-Requisite(s): SAT 2711

SAT 3812 - Network Security Engineering I
Planning and managing system security in a TCP/IP converged enterprise network environment. Topics include security architecture, attack methods and counter-measures, patch management, performance monitoring, security management tools, best practices, policy management, virus scanning, security protocols, intrusion detection, firewalls, and SSL/TLS.

Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Fall
Pre-Requisite(s): SAT 2511 and SAT 2711

SAT 3820 - Mobile Computing & FCC Regulations
Evolution of the wireless communications, standards, and regulations. Topics include IEEE 802.11a/b/g/ Physical & MAC Layer Standards, Site Survey, WLAN Security and Vulnerabilities, Troubleshooting, Personal, Metropolitan, and Wide Area Wireless Networks (Bluetooth, WiMax, Cellular & Satellite Networks).

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 4240 - VoIP 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 2010-2011 academic year
Restrictions: Must be enrolled in one of the following Major(s): Computer Network & System Admin

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 Admin

Pre-Requisite(s): SAT 1200 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 2009-2010 academic year
Pre-Requisite(s): SAT 3343

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: 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 Admin; Must be enrolled in one of the following Class(es): Senior

SAT 4541 - Windows 2000 Directory Services
Advanced concepts of planning and implementing enterprise services including LDAP directory service, Microsoft Active Directory and Kerberos in an enterprise environment. The course covers the concepts of sustainability, green computing and best practices in industry.

Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Fall, Summer
Pre-Requisite(s): SAT 3511(C) and SAT 3711

SAT 4600 - Web/App Server Administration
In depth study of Apache web server, Microsoft Internet Information Server (IIS) and email services. Topics include server configuration, load balancing, connecting to the Internet, web security and administration, communication media, HTTP, fault tolerance, and proxy servers.

Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Spring
Pre-Requisite(s): SAT 3511 and SAT 3711

SAT 4812 - Network Security Engineering II
Cryptographic, authentication, key distributions, and e-commerce security protocols. Security protocol properties: authentication, secrecy, integrity, availability, non-repudiation, atomicity, certified delivery; crypto-protocol attacks; security protocols design, implementation and analysis. Email, IP, and wireless security, virtual private networks, firewalls, content filtering, network security policies, and intrusion detection.

Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Spring
Pre-Requisite(s): SAT 3812

SAT 4880 - Senior Project II
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 Admin; 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 Admin; Must be enrolled in one of the following Class(es): Senior

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: Must be enrolled in one of the following Major(s): Computer Network & System Admin; Must be enrolled in one of the following Class(es): Senior

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 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): Computer Network & System Admin; 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, Spring
Restrictions: Must be enrolled in one of the following Major(s): Social Sciences, Liberal Arts with History Opt, Anthropology

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SS 1002 - Orientation to Legal Careers
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

SS 2100 - World Peoples & Environments
Introduction to two major disciplines, anthropology and geography, that focus on human diversity and the human relationship to environment and resources. Emphasizes patterns of culture and nature at different scales of human organization.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring, Summer

SS 2200 - Prehistory and Archaeology
Introduction to the methods of archaeology and the contributions of the discipline to understanding of world prehistory. Topics include the ways archaeologists discover and excavate sites, the analysis of archaeological artifacts and features, human evolution, and the patterns of world prehistory.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring, Summer

SS 2400 - Introduction to Human Geography
This course introduces students to concepts, problems, and case studies that make up the study of human geography: the spatial differentiation and organization of human activity, environmental sustainability, and the role of space and place in our everyday lives.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Pre-Requisite(s): UN 1002

SS 2500 - The American Experience
Covers selected topics related to historical development of American culture and society. Topics include American Revolution, slavery and Civil War, Jacksonian democracy, the West, urbanization and immigration, technology, work, Progressives and expertise, World War I, wealth and leisure, Americans and politics, mass communications and media, and the Great Depression.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring, Summer

SS 2550 - Themes in Western Civilization
Overview of the evolution of Western civilization. Reviews the major themes and movements that have influenced Western civilization, the factors that have contributed to its distinctiveness, and its impact on other civilizations.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall

SS 2600 - American Government & Politics
Outlines the principles and logic of American Government and politics and explores contemporary issues in national and state government.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring, Summer

SS 2610 - Introduction to Law and Society
Examining the civil and criminal justice system to explain how law informs yet is shaped by political, economic, and social forces. This course covers issues such as individual rights, the jury system, tort law, legal reform movements and constitutional interpretation.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2006-2007 academic year
Pre-Requisite(s): UN 1002(C) or UN 1003(C)

SS 2700 - Introduction to Sociology
Introduces students to the way that sociologists think about different components of society. Topics include the family, religion, markets, organizations, political systems, and educational systems. Also covers the source of individual values, beliefs, and attitudes.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Summer

SS 3100 - Developing Societies
An overview of the developing world. Asks "What is development?" in ecological, human, and economic terms. Explores variation among developing societies and elements of internal differentiation, including cultures, regions, classes, and genders. Emphasizes active student exploration of strategies for change, including technology, business, and political transformations.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2000-2001 academic year
Pre-Requisite(s): UN 1002 or UN 1003

SS 3200 - Historical Archaeology
Introduction to historical archaeology. Topics include the methods of historical archaeology, theoretical approaches, and sources of evidence. Emphasizes archaeological contributions to understanding of the American past, and the contributions of historical archaeology to an alternative view of American history and culture.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2008-2009 academic year
Pre-Requisite(s): UN 1002 or UN 1003

SS 3210 - Field Archaeology
Practical experience and training in the methods and techniques of field archaeology. Selected readings are followed by active participation in site survey, testing, excavation, record keeping, and analysis. Students benefit from involvement in ongoing research projects.
Credits: variable to 8.0; Repeatable to a Max of 8
Semesters Offered: Summer
Pre-Requisite(s): SS 2200

SS 3211 - Ethnographic Methods
Field-based course that surveys basic concepts of ethnography and applies them in a class-based research project. Provides practical experience in field observation, interviews, oral history, field notes, and write-up of research.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring - 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 2002

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 1002 or UN 1003)

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

SS 3240 - Reading the Landscape: Anthropology, Geography, History
Field-based course that surveys basic concepts of ethnography and applies them in a class-based research project. Provides practical experience in field observation, interviews, oral history, field notes, and write-up of research.
Credits: 3.0
Lec-Rec-Lab: (3-0-3)
Semesters Offered: Fall - Offered alternate years beginning with the 2007-2008 academic year
Pre-Requisite(s): UN 1002 or UN 1003

SS 3250 - Human Origins & Evolution
A human evolution course focusing upon a summary of general bioanthropological 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, Spring - 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 1002 or UN 1003 or SS 2100

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 1002 or UN 1003

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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: ethogenesis 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 1002 or UN 1003

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: Spring, Summer
Pre-Requisite(s): UN 2002

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 1002 or UN 1003

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 2001-2002 academic year
Pre-Requisite(s): UN 2002

SS 3500 - Modern American History
A broad survey of American history from World War II to the present.
Credits: 3.0
Lec-Rec-Lab: (2-0-3)
Semesters Offered: Spring, Summer
Pre-Requisite(s): UN 1002 or UN 1003

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, Spring
Pre-Requisite(s): UN 1002 or UN 1003

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: Spring, Summer - Offered alternate years beginning with the 2006-2007 academic year
Pre-Requisite(s): UN 2002

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
Pre-Requisite(s): UN 2002

SS 3512 - 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: Spring - Offered alternate years beginning with the 2000-2001 academic year
Pre-Requisite(s): UN 2002

SS 3520 - 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: Fall, Summer

SS 3525 - 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 2001-2002 academic year
Pre-Requisite(s): UN 1002 or UN 1003

SS 3530 - Europe to 1650
History of Europe from earliest times to 1650.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Pre-Requisite(s): UN 1002 or UN 1003

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 2002-2003 academic year
Pre-Requisite(s): UN 1002 or UN 1003

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: Fall, Spring, Summer

SS 3550 - Europe to 1650
History of Europe from earliest times to 1650.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Pre-Requisite(s): UN 1002 or UN 1003

SS 3551 - Europe in the Modern Era
A study of European history from 1650 to the present.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Pre-Requisite(s): UN 1002 or UN 1003

SS 3552 - Renaissance & Reformation
The history of Europe from 1300 to 1650.
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): UN 1002 or UN 1003

SS 3555 - History of England I
The social, economic, and political history of England to 1714.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Pre-Requisite(s): UN 1002 or UN 1003

SS 3556 - History of England II
History of England from 1714 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
Pre-Requisite(s): UN 1002 or UN 1003

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: Spring
Pre-Requisite(s): UN 1002 or UN 1003

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, Spring - Offered alternate years beginning with the 2000-2001 academic year
Pre-Requisite(s): UN 1002 or UN 1003
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, Spring - Offered alternate years beginning with the 2000-2001 academic year
Pre-Requisite(s): SS 2600 or UN 2002

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 court, 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
Pre-Requisite(s): UN 2002

SS 3620 - International Environmental Technology Policy
Explores the relationship between markets and government policies in moving national economies and corporations toward "greener" technology choices. Topics may include industrial ecology, regulation, innovation, and pollution prevention. Course employs examples from U.S., Canada, EU, and Japan. When possible, students work on a real-life project for a client.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring - Offered alternate years beginning with the 2000-2001 academic year
Pre-Requisite(s): UN 2002

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
Pre-Requisite(s): UN 2002

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 - 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): UN 2002(C)

SS 3650 - Intellectual Property Law, Technology, Society and Innovation
Principles of intellectual property law, addressing legal and contemporary policy issues in copyright, trademark and patent and how the law impacts the balance between property protections, technological innovation and public access. Emphasizes learning through lectures, case studies and simulations.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2006-2007 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

SS 3655 - Equality, Law, and Justice in the United States: Topics in Race, Class, and Gender
Explore legal construction of equality through the lens of ethnicity, sexuality, gender, and class. Discuss Supreme Court cases, legislation, news and film on issues such as right to privacy, reproduction, family, education, employment, free speech, free exercise, and criminal justice.
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
Pre-Requisite(s): SS 2600(C) or SS 2610 or UN 2002(C)

SS 3660 - American 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: 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 2002 or SS 2600

SS 3670 - Technology & Governance
This course will enable students to wrestle with the political and legal implications of emergent technology and science in modern societies. Readings will be drawn from contemporary and historical jurisprudence sources, relevant scientific and technical publications, and science studies literature.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2008-2009 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): SS 2600 or SS 2610

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): UN 2002 or SS 2700

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): UN 2002 or SS 2700

SS 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: (3-0-0)
Semesters Offered: Spring
Pre-Requisite(s): UN 2002 or PSY 2000

SS 3740 - Sociology of Family
Survey of marital and family relationships, which includes an examination of sex roles, courtship and mate selection, marital adjustment, sexual behavior, parenting, divorce, and the social forces that bring about changes in family patterns. Assumes familiarity with Social Sciences concepts and 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): UN 2002 or SS 2700

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): UN 2002 or SS 2700

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

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 - Offered alternate years beginning with the 2001-2002 academic year
Pre-Requisite(s): UN 2002
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
Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): UN 2002

SS 3810 - Anthropology of Science and Technology
An anthropological study of technological developments and scientific knowledge in different cultures. Examines how modes of thought in the 20th century have influenced the development of science and technology in the West. Utilizes case studies from anthropology to compare Western and non-Western approaches to scientific observation and technological choice.
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): UN 2002

SS 3820 - Ethical, Legal and Societal Implications (ELSI) of Nanotechnology
Exploration of the implications of molecularism—the 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 2007-2008 academic year
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): UN 2002

SS 3890 - Industry & the World Economy
Examines the impact of industry and industrial transformations at the local, regional, state, national, and global level. Analyzes topics such as the process of technological transformation, the modern corporation, the environmental consequences of industry, and the corporation and the nation state.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2001-2002 academic year
Pre-Requisite(s): UN 2002 or SS 2700

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
Pre-Requisite(s): UN 1002 or UN 1003

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 topics differ.
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

SS 3930 - Environmental Issues
Covers different environmental issues from year to year. Examples include air pollution, water pollution, endangered species, public land management, and toxics. Each course provides an in-depth exposure to the course topic, covering its sociopolitical and environmental components. May be repeated if topics differ.
Credits: 3.0; May be repeated
Lec-Rec-Lab: (3-0-0)
Semesters Offered: On Demand
Pre-Requisite(s): SS 2100 or SS 2200

SS 3940 - World Affairs
The study of current issues and themes in world affairs and of significant world tension areas. Detailed examination of central issues in selected recent regional or international conflicts or high profile internal problems in selected countries.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: On Demand
Pre-Requisite(s): UN 2002

SS 3950 - Topics in American History
Examines an important theme, topic, or era in the development of American society, ranging from the colonial era up to the present. May include such topics as the Vietnam War, sports in America, American vernacular architecture, or urban America, all from a historical viewpoint. 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): UN 1002 or UN 1003

SS 3960 - International Experience
Offers a means for crediting students for specific activities in study abroad programs that immerse them in foreign culture, society, and intellectual settings. It is applicable to varied study abroad and exchange programs offered by MTU.
Credits: variable to 9.0; Repeatable to a Max of 9
Semesters Offered: On Demand

SS 3990 - 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
Pre-Requisite(s): UN 2002

SS 4000 - Independent Study
Independent study of 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 4010 - 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 2002

SS 4010 - Social Science Methods
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: 4.0
Lec-Rec-Lab: (3-1-0)
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): UN 2002 and (PSY 2720 or MA 2720 or BA 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: Spring
Restrictions: Permission of department required; May not be enrolled in one of the following Class(es): Freshman
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
Pre-Requisite(s): SS 4990

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
Pre-Requisite(s): UN 2002
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: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Freshman Pre-Requisite(s): SS 2100

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: Fall, 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 1002 or UN 1003

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 4500 - Historiography
The history of historical writing from Herodotus to the present.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall, Spring - Offered alternate years beginning with the 2001-2002 academic year
Pre-Requisite(s): UN 1002 or UN 1003

SS 4510 - Sustainable Futures I
Covers introductory and intermediate concepts of Sustainable Development. Explores methods/tools for assessing sustainability (economic, environmental, societal impacts) of current and emerging industrial technologies. Explores relationships between government policies and markets for introducing sustainable technologies into national economies and corporations.
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): UN 2002

SS 4635 - Environmental Diplomacy and Law
This course delves into the international law associated with environmental issues. Students begin with the treaty language and associated jurisprudence (if any) and then move to how the treaty was negotiated, adapted by national governments, and used in political discourse.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2009-2010 academic year
Restrictions: Must be enrolled in one of the following Class(es): Sophomore, Junior, Senior
Pre-Requisite(s): SS 3610(C)

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
Pre-Requisite(s): UN 2002

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 intern 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 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: 2.0
Lec-Rec-Lab: (0-2-0)
Semesters Offered: Spring
Restrictions: Permission of instructor required; Must be enrolled in one of the following Class(es): Senior
Co-Requisite(s): SS 4030

SS 5010 - Directed Study
Directed readings or research conducted under the direction of a member of the graduate faculty. Students must meet with their supervising instructor and receive approval of their study plan before registering.
Credits: variable to 4.0; Repeatable to a Max of 9
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

SS 5100 - Global Environmental Systems
Survey of literature that connects global biological and physical processes with human adaptations, interventions and social systems. Study of range of human systems adapted to living in and with the environment. Topics include energy balance and transfer in the earth environment, ecosystems and energy flow, human intervention into geomorphological processes.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Level(s): Graduate

SS 5150 - Natural Hazards and Human Impacts
The interaction of humans and environment is examined through field study on the Keweenaw Peninsula. Focus on natural hazards, geological and geographical landscapes and processes. Integrates scientific and social scientific content knowledge with pedagogical approaches for K-12 teachers.
Credits: 3.0
Lec-Rec-Lab: (0-1-6)
Semesters Offered: Summer
Restrictions: May not be enrolled in one of the following Class(es): Sophomore, Junior

SS 5200 - Environmental Decision Making
Group practicum in environmental decision making. Focuses on facilitating the decision making process associated with a community-based environmental concern or policy choice. Past projects include efforts to facilitate public participation in developing a forest management plan and participating in a review of the Torch Lake Area of Concern.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate

SS 5300 - Environmental Policy and Politics
An overview of environmental policymaking and politics in the U.S. Emphasizes policies regarding air and water pollution, toxics and hazardous waste. Discussion of rulemaking, enforcement, and administration of laws by EPA. Investigation of environmental politics on national and community levels, with focus on social movements and citizen participation.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Level(s): Graduate

SS 5350 - Environmental Policy Analysis
The role of economic analysis in environmental policy, including a detailed review of the major tools that are used at the federal, state, regional, and local levels. Special emphasis on benefit-cost analysis and comparative risk analysis.
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): SS 5300
SS 5400 - Sociology of the Environment
Provides students with an introduction to basic sociological concepts as they apply human relationships to the environment. Topics include social values, organizations, norms, ideologies, and political systems. Themes will include the relationship of expertise to lay knowledge, public participation, and urban-rural relationships.
Credits: 3.0
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Level(s): Graduate

SS 5500 - IA Proseminar I: History of Technology
Provides a basic introduction to work in the history of technology. Students must also register for SS5501.
Credits: 2.0
Lec-Rec-Lab: (4-0-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Level(s): Graduate

SS 5501 - IA Proseminar II: Industrial Communities
A graduate seminar covering the main components of anthropological studies of industrial communities. Introduces the methods and approaches of this field through reading and discussion of selected articles and case studies. Students must also register for SS5500.
Credits: 2.0
Lec-Rec-Lab: (4-0-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Level(s): Graduate

SS 5502 - IA Proseminar III: Historical Archaeology
Graduate seminar covering the essential elements of historical archaeology through reading and discussion of selected articles and case studies. Students must also register for SS5503.
Credits: 2.0
Lec-Rec-Lab: (4-0-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate

SS 5503 - IA Proseminar IV: Material Culture Studies
Graduate seminar covering the basic elements of material culture studies through readings, discussion, and projects. Students must also register for SS5502.
Credits: 2.0
Lec-Rec-Lab: (4-0-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate

SS 5510 - Sustainable Futures I
Covers introductory and intermediate concepts of Sustainable Development. Explores methods/tools for assessing sustainability (economic, environmental, societal impacts) of current and emerging industrial technologies. Explores relationships between government policies and markets for introducing sustainable technologies into national economies and corporations.
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): UN 2002

SS 5520 - World History/Geography Themes
An immersion in thematic approaches to World History and Geography content. Lectures, discussions, and seminars will be used to deepen content knowledge for secondary school teachers.
Credits: variable to 4.0; Repeatable to a Max of 12
Semesters Offered: On Demand
Restrictions: Permission of department required; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

SS 5521 - Regional Approaches to World History and Geography for Teachers
Study of world history and geography focusing on China, India, Africa, Latin America, and the Middle East. Emphasis is on deepening content knowledge for secondary school teachers.
Credits: variable to 4.0; Repeatable to a Max of 12
Semesters Offered: On Demand
Restrictions: Permission of department required; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

SS 5600 - Industrial Archaeology
Directed readings and lectures in industrial archaeology using wide range of material from the historical engineering and archaeology literature. Central focus is on regional case studies. Students complete a substantial directed research project.
Credits: 4.0
Lec-Rec-Lab: (4-0-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Level(s): Graduate

SS 5635 - Environmental Diplomacy and Law
This course delves into the international law associated with environmental issues. Students begin with the treaty language and associated jurisprudence (if any) and then study how the treaty was negotiated, adapted by national governments, and used in political discourse. Unless the student has had a course in principles of public international law, there will be additional readings and writings to provide the fundamentals of international law.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2009-2010 academic year
Restrictions: Must be enrolled in one of the following Level(s): Graduate

SS 5700 - Archaeological Field Methods
Practical experience in methods and techniques of field archaeology. Background readings followed by participation in site survey, testing, excavation, and record keeping. Students involved in ongoing research projects in upper Great Lakes Region. Offered with SS 3210. Graduate students complete independent project in addition to regular work.
Recommended SS2020.
Credits: variable to 8.0; Repeatable to a Max of 16
Semesters Offered: Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate

SS 5800 - Documentation of Historic Structures
Provides students with an introduction to basic sociological concepts as they apply human relationships to the environment. Topics include social values, organizations, norms, ideologies, and political systems. Themes will include the relationship of expertise to lay knowledge, public participation, and urban-rural relationships.

SS 5900 - Heritage Management
Introduces the current field of heritage management; the legislation that underwrites its practice; the articulation of federal, state, and local governmental activity; the evolving philosophies of archaeologists and historic preservationists operating in the public interest; parallels on the international scene; and the impacts of heritage tourism.
Credits: 4.0
Lec-Rec-Lab: (4-0-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Level(s): Graduate

SS 5990 - Full Time Master's Research
Open to students who have successfully completed all the required courses as well as the required number of credits for the master's degree. Students in this course are involved in full-time research. Tuition for this course is charged at the graduate full-time research rate. Students enrolled in this course may not register for any other course.
Credits: 9.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-9-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

SS 5975 - Time Master's Research
Individual research work leading towards master's thesis or project. Open by arrangement to students in master's programs in the Department of Social Sciences.
Credits: variable to 10.0; Repeatable to a Max of 15; Graded Pass/Fail Only
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

SS 6010 - Special Topics in Industrial Heritage
Examines themes or topics related to studies of industrial heritage. May include such topics as advanced cultural resource & heritage management and tourism; industrial heritage field methods; international dimension of industrial heritage; government policy. May be repeated.
Credits: variable to 6.0; Repeatable to a Max of 12
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate
SS 6020 - Special Topics in Industrial History
Examines themes or topics related to the study of industrial history of technology. Topics may include global history of industrialization; theoretical models of industrial evolution; and social history of technology and work. May be repeated.
Credits: variable to 6.0; Repeatable to a Max of 12
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

SS 6500 - Directed Reading/Independent Study
Directed reading or independent study with appropriate faculty at the graduate level.
Credits: variable to 9.0; May be repeated
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate

SS 6600 - PhD. Dissertation Research
Fundamental and applied research in industrial heritage, industrial archeology, and history of technology. Taken by graduate students in partial fulfillment of the PhD thesis requirements.
Credits: variable to 9.0; May be repeated; Graded Pass/Fail Only
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Social Sciences

SS 6975 - Full-Time Doctoral Research
Open to students who have successfully completed all required courses as well as the comprehensive and proposal defense exams. Students in this course are involved in full-time research. Tuition for this course is charged at the graduate full-time research rate. Students enrolled in this course may not register for any other course.
Credits: 9.0; May be repeated; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-9)
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

Service Systems Engineering

SSE 2100 - Introduction to Service Systems Engineering
Introductory course covers the evolution of service systems engineering within the broader context of the engineering disciplines. Careers and professional practice within the discipline will be explored. Topics include systems analysis and design, introduction to quality tools and service systems engineering examples.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall

SSE 2300 - Service Systems Dynamics and Design
Introduces system dynamics principles and explores the effect of system structure and variable interactions on system behavior. Waiting line theory is introduced. Other topics include simulation, mental models, socio-technical systems, rational decision-making, and design.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Pre-Requisite(s): MA 3710(C) or MA 2720(C)

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: Spring
Pre-Requisite(s): MA 3710 or MA 2720

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.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Pre-Requisite(s): PSY 2000 and (MA 3710(C) or MA 2720(C))

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.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Pre-Requisite(s): MA 3710 or MA 2720

SSE 3600 - Optimization and Adaptive Decision Making
Techniques in optimization and adaptive decision making will be introduced. The fundamentals in linear, integer, and goal programming will be applied to real-world problems with a service systems focus. Adaptive decision making techniques including Bayesian analysis, fuzzy systems, and neural networks will also be investigated.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Pre-Requisite(s): MA 2320 or MA 2321 or MA 2330 and (MA 2720 or MA 3710)

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, Gannt, 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.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Pre-Requisite(s): MA 2720 or MA 3710

SSE 4600 - Managing Risk
Risk definition and identification in terms of financial, human, legal, and physical constraints will be introduced. Techniques for analyzing and managing risk such as FMEA and Reliability studies will be covered. Other topics will include risk elimination, mitigation, and tolerance.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Pre-Requisite(s): MA 2720 or MA 3710

Surveying

SU 1500 - Data Collection Systems
Familiarization to modern data collectors used in conjunction with total stations, GPS receivers, and digital levels. Transferring and displaying survey data within various systems. To include job creation, file types, feature codes, data entry, and COGO routines.
Credits: 1.0
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): MA 2320 or MA 2321 or MA 2330 and (MA 2720 or MA 3710)

SU 2000 - Intro to Surveying
Surveying topics will include distance measurements, leveling, angles, directions, traversing, horizontal and vertical curves, percent grade, and coordinate geometry. GIS topics will include sources of GIS data, spatial data models, GIS data structures, GIS topology, as well as query and feature selection in GIS.
Credits: 2.0
Lec-Rec-Lab: (0-1-2)
Semesters Offered: Fall, Spring

SU 2150 - Fundamentals of Surveying
Introduction to surveying principles as applied to the measurement of distances, directions, and elevations. Topics include taping, leveling, traversing, topographic surveys, construction surveys, U.S. public land surveys, the use of modern instrumentation, and computer applications.
Credits: 4.0
Lec-Rec-Lab: (0-2-6)
Semesters Offered: Fall

SU 2220 - Route and Construction Surveying
Study of the geometric field stike-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 2150

SU 2260 - Survey Computations
Introduction to the PLSS system and cadastral management software. Utilizing Mathead software to perform survey related computations for coordinate forms, intersections, resections, conformal transformations and Least Squares adjustment.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Pre-Requisite(s): SU 2150

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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 2260 and 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, 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 be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): SU 2260

SU 3250 - Geodetic Adjustments Theory
Presents errors in surveying measurements and their effect on computed values. Discusses analysis of measurements and errors based on statistical principles and presents adjustment techniques based on least squares principle.
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 2320 or MA 2321 or MA 2330) and (MA 2720 or MA 2710 or MA 3710) and MA 3160 and SU 2260

SU 3540 - Geospatial Information Technology with Elements of Field Cartography
Application of GIS technology methods for processing surveying data obtained in the field. Concepts of interoperability and metadata organization are considered. Includes map projection review and 2D and 3D cartographic data visualization.
Credits: 4.0
Lec-Rec-Lab: (0-3-3)
Semesters Offered: Spring
Pre-Requisite(s): MA 3710

SU 3560 - Geospatial Imaging Interpretation
Remote sensing methods applied to interpretation of topographic features from aerial and satellite imagery. Accuracy and applicability of remote sensing tools, imagery domains, operational work flows of remotely sensed imagery in field reconnaissance, map renovation, change detection and various essential applications.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Spring
Restrictions: Permission of department required
Pre-Requisite(s): PH 2200

SU 4003 - 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: (1-0-0)
Semesters Offered: On Demand

SU 4010 - Geodetic 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: (3-0-0)
Semesters Offered: On Demand
Restrictions: Permission of instructor required; Must be enrolled in one of the following Major(s): Surveying Engineering

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: (0-2-3)
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 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: (0-2-3)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): SU 2260

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: (0-2-1)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): SU 3180 and CMG 3200

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: (0-2-2)
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 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

SU 4997 - Independent Study in Geospatial Technologies
Independent study of an approved topic under the guidance of a Surveying Engineering 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): 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 Major(s): Surveying Engineering; Must be enrolled in one of the following Class(es): Senior

SU 4999 - Professional Practice Seminar
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
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior

SU 5002 - Infrared Technology, Sensors, and Applications
Infrared remote sensing fundamentals, current and future technologies, and applications are considered. Remote sensing for both civilian applications such as environmental resource mapping and military applications will be included.
Credits: 1.0
Lec-Rec-Lab: (1-0-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

SU 2260

SU 4003

SU 4060
SU 5003 - 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: 3.0
Lec-Rec-Lab: (1-0-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

SU 5004 - Introduction to Geospatial Image Processing
Introduction to the basic concepts of Image Processing and Understanding. Applications focus on preprocessing of satellite and aerial images, remote sensing, and image/video enhancement. This course will provide mathematical foundations and explore modern practical algorithms and methods.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

SU 5010 - 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: (3-0-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

SU 5020 - Data Analysis and Adjustments
Course explores fundamentals of mathematical error propagation theory including various observations equations, least squares adjustment, and Kalman filter methods. Blunder detection, decorrelation, inversion of patterned and large matrices processes are considered. Involves analysis of position estimation deploying geospatial measurements.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): SU 3250(C)

SU 5021 - Geodetic Models
Course provides solid geospatial background in geodetic reference frames: datums; geoids; and reference ellipsoids. 2D and 3D geodetic network adjustments are considered based on 3D spherical models.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): SU 5020(C)

SU 5022 - Positioning with GNSS
In depth study of GPS, GLONASS, Galileo, COMPASS satellite systems, theory and processing of global positioning measurements. Strongly recommended for geospatial practitioners.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): SU 5020

SU 5023 - Geospatial Positioning
High-level summary of GPS-GAP courses. This course is intended for interdisciplinary graduate students who seek just ONE combination course in adjustments, geodesy and GPS (with emphasis on GPS/GNSS). Not available to students who have taken SU5020, SU5021, SU5022.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

SU 5041 - Geospatial Data Processing
Advanced data collection techniques; raster to vector; data conversion and map projections; topology; principles and application via advanced spatial analysis; advanced database structure; geo-database; geo-relational data model versus object-component data model; advanced 3D applications; vector and raster data model application; network analysis; linear referencing and conflation; geo-coding; GIS-CAD integration; web-based GIS innovations.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

SU 5042 - Digital Cartography
Spatial relations - topology, relations and relationships, directions and distances; hierarchy; generalization - vector (linear, polygonal, fractals) and raster; labeling - automatic name placement, text arrangement and deletion text; computational geometric algorithms -line intersection, polygonal relationships, grid model, route analysis.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

SU 5043 - Topographic Analysis
LiDAR measurements; DSM - data sources, accuracy analysis, quality control, vector data analysis; terrain representation and TIN; grid analysis - interpolation, viability, filters (smoothing, edges, median), shading; merging overlapping DSMs; spatial analysis, spectral analysis, shape analysis; automatic feature extraction from DSM.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

SU 5930 - Synthetic Aperture Radar (SAR) Fundamentals and Applications
Review of radar concepts, applications of SAR (InSAR) data, types of available satellite/airborne systems, and data processing methods. Applications for creating topographic data, recognizing targets, classifying ice and vegetation, and oceans/large lakes will be presented based on real-world examples.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Fall, Summer

TE 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

TE 2000 - Directed Study in Technology
Students undertake a directed study in an approved technology topic under the guidance of a School of Technology faculty member. The course of study will be academic in nature and is decided upon between the student and the faculty member.
Credits: variable to 3.0; Repeatable to a Max of 6
Semesters Offered: On Demand
Restrictions: Permission of instructor and department required; Must be enrolled in one of the following College(s): School of Technology; Must be enrolled in one of the following Class(es): Freshman, Sophomore

TE 3500 - Quality Techniques
This course offers an in depth examination of the key elements of quality systems used by organizations. Topics will include cause and effect analysis, loss prevention, process control, vendor management, advanced quality planning and policy analysis.
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): MA 2720(C)

TE 3956 - Industrial Safety Management
Occupational safety and health standards and codes. Hazard recognition, accident costs, accident prevention, ethics and administration.
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

TE 4200 - Leadership in Complex Organizations
This senior level course explores the traditional and emerging models of leadership as they exist in contemporary organizations. Topics will include organizational theory, critical theory, leadership development, and organizational learning.
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
TE 4580 - Facilities Planning, Layout and Process Flow
This course examines the methods used to collect and analyze the necessary data in designing an efficient manufacturing facility. Attention will be given to site and equipment selection, layout and flow analysis.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Class(es): Senior

TE 4590 - Production Planning and Control
This course studies the modern methods for the systematic planning and control of operations necessary to produce a product or service.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Class(es): Senior

TE 4986 - 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

TE 5000 - Independent Study in Technology
Students undertake an independent study in an approved technology topic under the guidance of a School of Technology faculty member. The course of study may either be research or academic and is decided upon between the student and faculty member.
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): Senior

UN 1000 - Perspectives on Inquiry
Writing-intensive course which engages students in college level inquiry. Students develop fundamental intellectual habits, understand how to integrate various perspectives on knowledge, and begin to learn how to meet the changing needs of a global, technological, diverse, and environmentally sensitive society.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Class(es): Freshman

UN 1002 - World Cultures
Examines diversity and change around the globe from perspectives of social sciences, humanities, and arts; explores human experience from prehistory to present. Classroom lectures accompanied by films, live performances, and guest speakers. One complete year of a single foreign language plus World Cultures (UN1003, 1-credit-activities) substitutes for World Cultures.
Credits: 4.0
Lec-Rec-Lab: (3-0-3)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Class(es): Freshman

UN 1003 - World Cultures Activities
Activities portion of World Cultures. Limited to enrollment by students choosing the modern language option of one full year of a single foreign language to fulfill their World Cultures requirement.
Credits: 1.0
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Class(es): Freshman

UN 1010 - Creating Your Success
Introduction to strategies for creating academic, professional and personal success. Emphasis is on determining individual priorities, improving self-management and developing critical thinking skills. Guided journal writing will be used to explore these strategies.
Credits: 1.0; Repeatable to a Max of 3; Graded Pass/Fail Only
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Fall, Spring, Summer

UN 1100 - Foundations of Global Leadership
Seminar course designed for participants in the Pavlis program. Offers an introduction to theories of communication relevant to leadership in a global context and examines the relationships among globalization, diversity, culture, communication, and the practices of effective leadership.
Credits: 1.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Fall, Spring
Restrictions: Permission of instructor required

UN 1200 - Foundations of Environmental Leadership
Seminar course designed for students in the Pavlis program. Builds upon theories of communication covered in UN1100 with particular emphasis on their application to global environmental issues. Examines the role of environmental ethics and sustainability in effective leadership.
Credits: 1.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Spring
Pre-Requisite(s): UN 1100

UN 1995H - Honors Institute Contract
Credits: 0.0; Graded Pass/Fail Only
Semesters Offered: On Demand

UN 2001 - Revisions: Oral, Written, and Visual Communication
Oral, Written, and Visual Communication. Writing-intensive course which builds on students' previous courses by providing advanced, direct instruction in communication. Students look closely at the communication practices of civic groups and apply what they learn to their own spoken, written, and visual work. Class projects ask students to fit the communications they make to interesting, sometimes difficult, situations and audiences.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): UN 1001 and (UN 1002 or UN 1003)

UN 2002 - Institutions
From families to governments, to markets, to our interactions with the natural environment, institutions organize collective human action. Introduces students to the nature and role of institutions in shaping today's world. Specific topics will vary by section, but all sections address a set of core questions and concepts.
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): Sophomore
UN 2100 - Foundations of Technological Leadership
Seminar course designed for students in the Pavlis program. Builds upon communication and leadership topics covered in UN1200 with an emphasis on technology in a globalized world. Also theorizes and develops skills essential for effective innovation, entrepreneurship, and creativity.
Credits: 1.0
Lec-Rec-Lab: (0-0-3)
Semesters Offered: Fall
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 - Offered alternate years beginning with the 2007-2008 academic year

UN 2990 - Special Topics - Interdiscip.
The 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 2995H - Honors Institute Contract
Credits: 0.0; Graded Pass/Fail Only
Semesters Offered: On Demand

UN 3002 - Undergraduate Cooperative Education Laboratory
Credits may count as free or technical electives based on student's academic department. Requires 2.20 GPA or better, registration with the Office of Cooperative Education, and acceptability by a recognized employer. Transfer students must have completed at least one full-time semester on the MTU campus.
Credits: variable to 2.0; May be repeated
Restrictions: Permission of instructor and department required. May not be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Class(es): Sophomore, Junior, Senior

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: Fall, Spring, Summer
Restrictions: Permission of instructor and department required. May not be enrolled in any of the following Level(s): Graduate; Must be enrolled in one of the following Level(s): Sophomore, Junior, Senior

UN 3200 - Global Technological Leadership
This course, designed for students in the Pavlis program, covers topics of leadership including personality traits, interpersonal skills, leadership styles, teamwork, situational leadership, and decision making. Offers practical experience in project development, communication, and leadership development.
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): UN 2100

UN 3404 - Cultural 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: (0-1-1)
Semesters Offered: Summer
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): UN 2100

UN 3405 - Language Fundamentals
This course, designed for students in the Pavlis program, provides an opportunity for students to explore the basic and essential elements of language spoken in the host country using online resources and native speakers to facilitate leadership development abroad.
Credits: 2.0
Lec-Rec-Lab: (0-0-6)
Semesters Offered: Summer
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): UN 3404, UN 3406

UN 3406 - Language of Business, Technology, and the Environment
This course, designed for students in the Pavlis program, will allow students to explore 1) business and management culture, 2) engineering & technology tools, tactics, and processes associated with design and development of new products and technological systems, and 3) topics of environmental stewardship associated with the location of their international experience.
Credits: 2.0
Lec-Rec-Lab: (1-0-1)
Semesters Offered: Summer
Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): UN 3404, UN 3405

UN 3995H - Honors Institute Contract
Credits: 0.0; Graded Pass/Fail Only
Semesters Offered: On Demand

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
Semesters Offered: Fall, Spring
Restrictions: May not be enrolled in one of the following Class(es): Junior
Pre-Requisite(s): UN 1200

UN 4050 - Global Leadership Practicum
Students in the Pavlis program will spend time abroad participating in a variety of leadership experiences including at least one major leadership project. Upon returning, students will spend two weeks on campus writing reports and hosting an on-campus leadership institute.
Credits: 7.0
Lec-Rec-Lab: (0-0-12)
Semesters Offered: Summer
Restrictions: Permission of department required; Must be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): UN 3404 and UN 3405 and UN 3406

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 4050

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 4100

UN 4990 - Special Topics - Interdisciplinary
Study of interdisciplinary special topics as specified by section title.
Credits: variable to 6.0; May be repeated
Restrictions: Permission of instructor required

UN 4995H - Honors Institute Contract
Credits: 0.0; Graded Pass/Fail Only
Semesters Offered: On Demand

UN 5000 - Cooperative Education - Graduate
Offered by each participating college or school-the graduate-level cooperative education course. Requires advisor approval, registration with the Career Center Co-op Office, acceptability by a recognized employer. Student must have completed one full-time semester on the MTU campus.
Credits: variable to 12.0; May be repeated
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate
UN 5951 - Graduate Status - Maintenance of Continuous Enrollment
Meets continuous enrollment requirement for graduate students needing "time out" for special circumstances (such as active military duty) and for programs with inactive terms.
Credits: 0.0; May be repeated; Graded Pass/Fail Only
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

UN 5953 - Final-Term Graduate Registration
Course can be used to meet the one credit final semester enrollment requirement for graduate students completing degree; students enrolled in research-oriented degree programs are advised to register in one credit of research with appropriate faculty member.
Credits: 1.0; Graded Pass/Fail Only
Lec-Rec-Lab: (0-1-0)
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

UN 5990 - 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
Appendix A: Refund/Repayment Policies

Refunds of Tuition/Fees
Students will be assessed tuition and fees according to the number of credits for which they are registered on Wednesday of the second week of the semester. Credits added after this date will be assessed tuition, but financial aid will not be adjusted.

Schedule adjustments—Courses dropped by the close of business on Wednesday of the second week of the semester will be refunded 100 percent for tuition and fees. Courses dropped after this time for students who otherwise remain enrolled at Michigan Tech will not be refunded, and additional tuition and fees will be incurred if credits are added.

Half-semester courses, including most summer semester courses, or any other courses offered in a time module other than a fourteen-week semester, will be prorated according to the refund schedule and the equivalent percentage of time.

Refund dates for half-semester and full-semester courses are posted on the Academic Calendar at www.mtu.edu/registrar/, or contact the Registrar’s Office for information on refund dates for all other courses.

University Withdrawal—The following refund schedule applies when students drop all classes and leave the University. This does NOT apply to students making schedule adjustments who otherwise remain enrolled at Michigan Tech.

Students receive 100 percent refund of tuition and fees when all classes are dropped prior to the first day of the semester.

Refunds for classes offered in a time module other than a fourteen-week semester will be prorated according to this schedule and the equivalent percentage of time.

<table>
<thead>
<tr>
<th>Time of Withdrawal</th>
<th>Refund Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Through Wednesday of the first week</td>
<td>100%</td>
</tr>
<tr>
<td>Thursday and Friday of 1st week</td>
<td>90%</td>
</tr>
<tr>
<td>2nd week</td>
<td>80%</td>
</tr>
<tr>
<td>3rd week</td>
<td>70%</td>
</tr>
<tr>
<td>4th week</td>
<td>60%</td>
</tr>
<tr>
<td>5th week</td>
<td>50%</td>
</tr>
<tr>
<td>6th week</td>
<td>40%</td>
</tr>
</tbody>
</table>

Room and Board Refunds—Refunds of room-and-board charges will be prorated on the basis of the number of weeks used.

Enrollment Deposit—The enrollment deposit is refundable within six months of leaving the University. Unpaid charges such as library fines, traffic fines, lab charges, and other penalties will be deducted from the refund of the deposit.

Credit Balance Refunds—Credit balance refunds resulting from the receipt of financial aid or overpayment will be issued during the third week of the semester. Credit balances as a result of Federal Direct Loan proceeds will be refunded when the credit appears on the student’s account. Refund checks cannot be picked up in the Cashier’s or Accounting Offices. Checks are mailed or direct deposited into the student’s checking or savings account.
It is the student’s responsibility to maintain correct addresses. Mailing addresses (local address where refund checks will be sent) may be updated through Banweb (Student Information System).

A $10 fee will be assessed to the student’s account if he or she requests a stop payment and reissue of a credit balance check within fifteen days from the date of issue. No fee will be assessed if the request comes fifteen days or later after the date of issue.

Financial Aid Refund Policy

Return of Title IV Funds

Students who completely withdraw from all courses prior to completing more than 60 percent of a semester will have their eligibility for aid recalculated based on the percent of the semester completed. This policy shall apply to all students who withdraw, drop out, or are dismissed from the University and receive financial aid from Title IV funds.

The term “Title IV Funds” refers to the following federal financial aid programs: Federal Direct Unsubsidized Loan, Federal Direct Subsidized Loan, Federal Direct PLUS Loans, Federal Perkins Loan, Federal Pell Grant, Federal Supplemental Educational Opportunity Grant, Academic Competitiveness Grant and National Science and Mathematics Access to Retain Talent Grant (SMART).

Title IV aid is earned in a prorated manner on a per diem basis up to and including the 60 percent point in the semester. Title IV funds and all other aid are viewed as 100 percent earned after that point in time.

The percentage of Title IV aid earned shall be calculated as follows:

\[
\frac{\text{Number of days completed by the student}}{\text{Total number of days in the semester}} = \text{Percent of Title IV aid earned}
\]

* The total number of days in the semester includes weekends but does not include any scheduled breaks of more than five days.

A student's withdrawal date is determined by the University as (1) the date the student began the university’s withdrawal process or officially notified the Office of Records and Registration of intent to withdraw; or (2) the midpoint of the semester for a student who leaves without notifying the university; or (3) the student’s last date of attendance at a documented academically related activity.

University’s Portion to be Returned—The percentage of Title IV aid unearned (i.e., to be returned to the appropriate program) shall be 100 percent minus the percent earned. Any unearned aid to be returned by the University is the lesser of (1) the entire amount of unearned aid or (2) the total institutional charges multiplied by the percentage of unearned aid.

Unearned Title IV aid shall be returned according to the following priority up to the amount received for the semester:

1. Direct Unsubsidized Loan
2. Direct Subsidized Loan
3. Perkins Loan
4. Direct PLUS Loan (Graduate Student)
5. Direct PLUS Loan (Parent)
6. Federal Pell Grant
7. Academic Competitiveness Grant
8. National SMART Grant
9. Federal SEOG

Student’s Portion to be Returned—When the total amount of unearned aid is greater than the amount returned by the University from the student’s account, the student is responsible for returning unearned aid to the appropriate program(s). The same priority as above should be used. Any loan funds that must be returned by the student will be repaid according to the terms of the promissory note. There is a 50-percent discount on any grant...
funds that are to be repaid. Grant funds that must be returned are considered a federal grant overpayment. The student can either repay the amount in full or make satisfactory arrangements with the University or the Department of Education to repay the amount due. These arrangements must be completed within forty-five days of the date the University notifies the student of the overpayment status or the student risks losing eligibility for further federal financial assistance.

**Return of Non-Title IV Funds**
The portion of state, University, and other assistance that must be returned will be calculated based on the particular program's return policy.

The student will be billed for any amount due to the University resulting from the return of Title IV and Non-Title IV funds.
Appendix B: Standards of Progress for Financial Aid

Satisfactory Progress Policy


This policy defines the minimum requirements for financial aid eligibility at Michigan Tech. Note that other types of financial aid (e.g., scholarships) may have more stringent requirements.

Students who do not meet the GPA requirements after any semester are not considered to be making satisfactory progress, and the affected financial aid for subsequent semesters will be canceled with the following exception: students who do not meet the GPA requirement after their first semester at Michigan Tech will be placed on financial aid probation and will remain eligible for financial aid for one semester. Students not meeting the schedule of credits passed after spring semester are not considered to be making satisfactory progress. Both GPA and credits passed requirements must be met for aid to be reinstated.

Requirement 1. Minimum Grade Point Average
Every student must maintain, at the end of each semester, a cumulative grade point average of at least

1.70 as a first-year student (0–29 credits)
1.80 as a sophomore (30–59 credits)
2.00 as a junior (60–89 credits)
2.00 as a senior (90 or more credits)
2.00 as a postgraduate student
3.00 as a graduate student (MS, PhD)

Requirement 2. Minimum Credits Passed
Every student must adhere to the following schedule of credits passed, even if the academic major is changed. Audited courses (U or V) do not count toward credits earned. Transfer students, see below for additional information.
Credits Earned at Michigan Tech

<table>
<thead>
<tr>
<th>Full-Time Semesters at Michigan Tech</th>
<th>Undergraduate Student</th>
<th>MS Student</th>
<th>PhD Student</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>9</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>1.5*</td>
<td>13</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>18</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>3</td>
<td>28</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>4</td>
<td>38</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>5</td>
<td>49</td>
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<tr>
<td>6</td>
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<td>7</td>
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</tr>
<tr>
<td>8</td>
<td>82</td>
<td>32</td>
<td>32</td>
</tr>
<tr>
<td>More than 8</td>
<td>—</td>
<td>no aid</td>
<td>—</td>
</tr>
<tr>
<td>9</td>
<td>94</td>
<td>no aid</td>
<td>36</td>
</tr>
<tr>
<td>10</td>
<td>106</td>
<td>—</td>
<td>40</td>
</tr>
<tr>
<td>11</td>
<td>118</td>
<td>—</td>
<td>44</td>
</tr>
<tr>
<td>12</td>
<td>130</td>
<td>—</td>
<td>48</td>
</tr>
<tr>
<td>More than 12</td>
<td>no aid</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>13</td>
<td>—</td>
<td>—</td>
<td>52</td>
</tr>
<tr>
<td>14</td>
<td>—</td>
<td>—</td>
<td>56</td>
</tr>
<tr>
<td>More than 14</td>
<td>—</td>
<td>—</td>
<td>no aid</td>
</tr>
</tbody>
</table>

Eligibility Defined

All students, regardless of whether they are receiving aid, have a limited number of semesters for which they are eligible for such aid. For example, undergraduates who have attended Michigan Tech for 8 full-time semesters may be eligible for another 4 semesters of aid, regardless of whether or not they have received aid in the past. Every semester an undergraduate student is enrolled for 12 or more credits at the end of the official add period counts as a full time semester. If an undergraduate student is enrolled for 6-11 credits, the full-time semesters increase by one half. Full-time semesters will not increase during the semesters undergraduate students carry fewer than 6 credits.

Associate Degree Students—The undergraduate schedule of credits passed applies to students in associate degree programs. If the full-time semesters exceed 6, the student is not considered to be making satisfactory progress. Appeals based on the fact that some credits earned at Michigan Tech were used for a previous degree should be presented to the Financial Aid Office.

Students with Transfer Credit—The appropriate schedule of credits earned applies to students with transfer credit, with one additional step. The total number of credits transferred to Michigan Tech is divided by 15 to calculate full-time transfer semesters. That number is then subtracted from the total number of full-time semesters of eligibility at Michigan Tech to determine the number of semesters of eligibility remaining. If the combination of full-time semesters at Michigan Tech plus the full-time semesters calculated from transfer credit exceeds the maximum allowed (12), the student is not considered to be meeting satisfactory progress requirements for financial aid. Example: A student who is transferring 60 semester credits to Michigan Tech would have 4 full-time transfer semesters (60 credits/15=4 semesters). The student in this example would have 8 full-time semesters of eligibility remaining (12 semesters maximum minus 4 calculated transfer semesters=8 semesters of remaining eligibility).
**Students Working on Second Undergraduate Degree**—Undergraduate students who have received their first bachelor's degree from another institution are considered to be making unsatisfactory progress when their full-time Michigan Tech semesters exceed 6. Michigan Tech undergraduates seeking a second bachelor's degree must follow the schedule of credits passed for undergraduate students.

**Appeals and Reinstatements**

Because financial aid dollars are applied to the first billing each semester, and the progress status is not determined until semester-end grades are processed, necessary adjustments will appear on a subsequent billing of the semester following a change of progress status.

If completion of temporary grades (I or X) or other transcript changes (e.g., grade changes) warrant reinstatement, the student should notify the Financial Aid Office by the end of the semester following unsatisfactory progress.

Students not meeting the satisfactory progress requirements because of mitigating or extenuating circumstances may request reinstatement of financial aid by submitting a Satisfactory Progress Appeal Request Form along with the specified documentation. This form can be obtained from the Financial Aid Office or downloaded from the Financial Aid Office website. Appeals should be submitted to the Financial Aid Office no later than Tuesday of the first week of the semester following unsatisfactory progress. If a student's appeal is approved, when appropriate, the full-time semesters will be adjusted allowing continued eligibility.

**NCAA Eligibility Requirements**

The National Collegiate Athletic Association (NCAA) requires that student-athletes be in good academic standing and maintain satisfactory academic progress toward a baccalaureate degree to remain eligible to represent an institution in intercollegiate athletics competition. The following table lists the total number of credits that must be complete and the minimum cumulative GPA that must be attained by a student-athlete at Michigan Technological University by the end of each academic year to meet NCAA eligibility requirements.

**Division I — Men's Ice Hockey:**

1. Must declare a major by the start of the third year to be eligible to compete.
2. Student-athletes must be in good standing with the University (not withdrawn or suspended).

<table>
<thead>
<tr>
<th>Entering 2nd Year of Collegiate Enrollment</th>
<th>Entering 3rd Year of Collegiate Enrollment</th>
<th>Entering 4th Year of Collegiate Enrollment</th>
<th>Entering 5th Year of Collegiate Enrollment</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 semester credits</td>
<td>40% of degree requirements</td>
<td>60% of degree requirements</td>
<td>80% of degree requirements</td>
</tr>
<tr>
<td>18 credits earned during academic year</td>
<td>18/27 credits earned during academic year</td>
<td>18 credits earned during academic year</td>
<td>18/27 credits earned during academic year</td>
</tr>
<tr>
<td>1.80 GPA for graduation</td>
<td>1.80 GPA for graduation</td>
<td>2.00 GPA for graduation</td>
<td>2.00 GPA for graduation</td>
</tr>
<tr>
<td>Six credits/term</td>
<td>Six credits/term</td>
<td>Six credits/term</td>
<td>Six credits/term</td>
</tr>
<tr>
<td>A maximum of six semester hours of remedial courses may be used in the first year</td>
<td>Declaration of degree program</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Updated 4/25/08
Division II
A student-athlete must pass at least 24 credit hours of college work during the two (2) previous semesters or have an average of 12 credits each term attended (summer school can only account for 25 percent of the 24 credits) and maintain the following grade point average:

**GPA Requirements**
1.80—After completion of 24 semester credit hours.
2.00—After completion of 48 semester credit hours, or thereafter.

**Six Credit Hours Eligibility Requirement**
All student-athletes currently enrolled must successfully complete at least six semester hours in the previous regular academic term of full-time enrollment to be eligible to participate in the next regular academic term. Student-athletes not meeting the satisfactory progress requirements because of mitigating or extenuating circumstances may request reinstatement by writing a letter of appeal to the Athletic Department, care of the Compliance Office, within one week of notification of loss of eligibility.

**Veterans' Standards of Progress**
The veterans' standards of progress are the same as for all other University students as listed under Academic Policies and Procedures.

1. All students receiving veterans' benefits must maintain a cumulative grade point average of 2.00. Failure to maintain that GPA will result in the student being placed on probation. A student will be allowed two terms, including the summer session, to raise the cumulative GPA to that required for graduation to come off probation. If the student fails to remove himself or herself from probation, the US Department of Veterans Affairs (USDVA) will be notified in writing. Requests for reinstatement of VA benefits will be made only after a veteran has been removed from probation and has attained a cumulative GPA of 2.00 (on a 4.00 scale).
2. Student veterans not registered by the fifth day of instruction will be terminated from benefits.
3. All student veterans receiving benefits must schedule a minimum of 12 credits of their major core requirements to receive full benefits.
4. Repeated courses are authorized for student veterans receiving benefits only if the course being repeated is a major, minor, or core requirement. Repeating a non-failing grade is not considered VA certifiable.
5. Two-year technology courses are not authorized for certification for student veterans enrolled in a four-year program.
6. All accepted applicants who are requesting veterans' benefits will be given credit for previous training, where appropriate. The total length of time will be reduced proportionately toward completion of degree requirements. All students receiving veterans' benefits must submit transcripts and other documents showing credit for previous training to the Admissions Office by the end of the first term of enrollment. Failure to do so will result in no further certification for veterans' benefits until those transcripts have been provided.

**Financial Aid**
For scholarship information, go to the financial aid website at [www.finaid.mtu.edu](http://www.finaid.mtu.edu)
Appendix C: Assessment, Leadership, Accreditation

Assessment
Michigan Technological University is committed to continuous improvement of its educational programs. An important part of our improvement effort is Michigan Tech’s program for Assessment of Student Learning. In each department, our faculty set goals for student learning that go beyond the content of any single course. Examples include "a unified and integrated understanding of their major field as a whole, skills for critical thinking and systematic analysis," and "good oral and written communications skills."

To measure students' success in achieving these learning goals, we collect samples of student work, administer special exams, and conduct student interviews throughout the year. The purpose of this assessment is to identify opportunities for improvement of our curricula and student life by measuring the success of students as a group. The university also participates in national surveys, such as the National Survey on Student Engagement.

The results of assessment activities are summarized each fall as a report and discussed by the faculty in each department as well as by the University Assessment Council annually to determine how the curriculum and teaching practices may be revised to improve student learning. The University administration reviews assessment activities and uses informed findings to help make decisions about program growth.

Board of Control
(All terms expire December 31 of year indicated.)

<table>
<thead>
<tr>
<th>Name</th>
<th>City, State</th>
<th>Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thomas L. Baldini</td>
<td>Marquette, Michigan</td>
<td>2009-2016</td>
</tr>
<tr>
<td>Dr. Kathryn I. Clark</td>
<td>Ann Arbor, Michigan</td>
<td>2005–2012</td>
</tr>
<tr>
<td>Russell A. Gronevelt</td>
<td>Plymouth, Michigan</td>
<td>2004–2010</td>
</tr>
<tr>
<td>Stephen J. Hicks</td>
<td>Marquette, Michigan</td>
<td>2007–2014</td>
</tr>
<tr>
<td>Paul G. Ollila</td>
<td>Painesdale, Michigan</td>
<td>2009-2016</td>
</tr>
<tr>
<td>Dr. Ruth A. Reck</td>
<td>Davis, California</td>
<td>2002–2010</td>
</tr>
<tr>
<td>Martha K. Richardson</td>
<td>Grosse Pointe Farms, MI</td>
<td>2005–2012</td>
</tr>
</tbody>
</table>

University Administrators
President, Glenn D. Mroz
Provost and VP for Academic Affairs, Maximilian J. Seel
VP for Student Affairs, Les P. Cook
VP for Administration, Ellen S. Horsch
VP for Advancement, Shea McGrew
VP for Governmental Relations; Sec'y, Board of Control, Dale R. Tahtinen
VP for Research, David D. Reed
Chief Financial Officer/Treasurer, Board of Control, Daniel D. Greenlee

Faculty Administration
College of Engineering
Dean, Timothy J. Schulz
Associate Dean Research and Graduate Programs, Carl L. Anderson
Associate Dean for Academic Affairs, Leonard J. Bohmann

Department Chairs
Biomedical Engineering, Michael R. Neuman
Chemical Engineering, S. Komar Kawatra
Civil and Environmental Engineering, William M. Bulleit
Electrical and Computer Engineering, Daniel R. Fuhrmann
Engineering Fundamentals, Jean-Celeste Kampe
Geological and Mining Engineering and Sciences, Wayne D. Pennington
Materials Science and Engineering, Mark R. Plichta
Mechanical Engineering-Engineering Mechanics, William W. Predebon

College of Sciences and Arts
Dean, Bruce E. Seely
Associate Dean, Bradley H. Baltensperger

Department Chairs
Aerospace Studies (Air Force ROTC), Kerry L. Beaghan
Biological Sciences, Kenneth Michael Gibson
Chemistry, Sarah A. Green
Cognitive and Learning Sciences, Bradley H. Baltensperger
Computer Science, Linda M. Ott
Exercise Science, Health and Physical Education, Jason R. Carter
Humanities, Ronald Stickland
Mathematical Sciences, Mark S. Gockenbach
Military Science (Army ROTC), James W. Spence
Physics, Ravindra Pandey
Social Sciences, Patrick E. Martin
Visual and Performing Arts, Roger L. Held

School of Business and Economics
Dean, Darrell J. Radson
Associate Dean, Thomas E. Merz

School of Forest Resources and Environmental Science
Dean, Margaret R. Gale

School of Technology
Interim Dean, James Frendewey

Graduate School
Dean, Jacqueline E. Huntoon

J. R. Van Pelt Library
Interim Director, Christa L. Walck
University Accreditation
Michigan Technological University is accredited by: North Central Association of Colleges and Schools, the Higher Learning Commission. Accreditation documentation may be reviewed in the Office of the Provost and Vice President for Academic Affairs.

North Central Association of Colleges and Schools, the Higher Learning Commission
30 North LaSalle St, Suite 2400
Chicago, IL 60602-2504
312-263-0456 and 800-621-7440; 312-263-7462 (fax)
www.ncahigherlearningcommission.org

In addition to the general accreditation, specific programs have been accredited, approved, or recognized by their respective agencies.

College of Engineering
The following engineering programs are accredited by the Engineering Accreditation Commission of ABET, 111 Market Place, Suite 1050, Baltimore, MD 21202-4012, telephone: (410) 347-7700.
• biomedical engineering
• chemical engineering
• civil engineering
• computer engineering
• electrical engineering
• engineering (interdisciplinary or special focus)
• environmental engineering
• geological engineering
• materials science and engineering
• mechanical engineering

School of Technology
The following engineering technology programs are accredited by the Technology Accreditation Commission of ABET, 111 Market Place, Suite 1050, Baltimore, MD 21202-4012, telephone: (410) 347-7700.
• electrical engineering technology
• mechanical engineering technology

College of Sciences and Arts
The Department of Chemistry offers American Chemical Society certified degrees and interdisciplinary options. Fourth-year instruction in the Clinical Laboratory Science 3+1 option is carried out in hospitals accredited by the National Accrediting Agency for the Clinical Laboratory Sciences (NAACLS).

The Michigan Board of Education approves the teacher certification programs.

School of Business and Economics—AACSB International
The BSBA degree program of the School of Business and Economics is accredited by AACSB International -The Association to Advance Collegiate Schools of Business, the premier business accrediting organization in the US. Only about 400 US business programs (of 1,200 nationwide) have earned this distinction.
AACSB International
777 South Harbour Island Boulevard, Suite 750
Tampa, FL 33602-5730 USA
813-769-6500; 813-769-6559 (fax)

School of Forest Resources and Environmental Science
The Society of American Foresters accredits the forestry program.
Society of American Foresters
6400 Grosvenor Lane
Bethesda, MD 20814-2198
301-897-8720; 301-897-3690 (fax).