

# Undergraduate Catalog 2011



**MichiganTech**  
Create the Future

## 2010-11 Academic Calendar

<b>Fall Semester</b>		
Week 1	August 30, Monday	Instruction begins
Week 2	September 6, Monday	Labor Day recess, 1 day only
	September 10, Friday noon	K-Day recess
Week 3	September 13, Monday	Classes resume
Week 12	November 19, Friday 10:00 pm	Thanksgiving recess begins
Week 13	November 29, Monday	Classes resume
Week 14	December 10, Friday	Last day of regular classes
	December 11, Saturday	Mid-year commencement
	December 13, Monday – December 17, Friday	Final exam period
	December 17, Friday	Fall Semester ends
<b>Spring Semester</b>		
Week 1	January 10, Monday	Instruction begins
Week 2	January 17, Monday	Martin Luther King Day recess, 1 day only
	January 18, Tuesday	Classes resume
Week 5	February 9, Wednesday 10:00 pm	Winter Carnival recess begins
Week 6	February 14, Monday	Classes resume
Week 8	March 4, Friday 10:00 pm	Spring Break begins
Week 9	March 14, Monday	Classes resume
Week 14	April 22, Friday	Last day of regular classes
	April 25, Monday – April 29, Friday	Final Exam period
	April 29, Friday	Spring Semester ends
	April 30, Saturday	Commencement
<b>Summer Session</b>		
Week 1	May 9, Monday	Full session begins
	May 9, Monday	Session A begins
Week 4	May 30, Monday	Memorial Day recess, 1 day only
Week 7	June 23, Thursday	Session A ends
	June 24, Friday	Session A exam period
Week 8	June 27, Monday	Session B begins
Week 9	July 4, Monday	Independence Day recess, 1 day only
Week 14	August 11, Thursday	Session B ends
Week 14	August 11, Thursday	Full Session ends
Week 14	August 12, 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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### **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).*



## About Michigan Tech

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

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



## 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	487-2440
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

# Academic Programs

The requirements for all associate and baccalaureate degree programs, as well as the requirements for certificates and minors and contact information for each of the colleges and schools for the 2011-12 academic year, are listed below.

- [Associate Degree Programs](#)
- [Baccalaureate Degree programs](#)
- [Minors](#)
- [Certificates Programs](#)
- [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](#)
- [Additional Baccalaureate 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)



## Baccalaureate Degrees



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)  
Economics (BEC)  
Economics-Secondary Education (BEC2)  
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)  
Electrical Engineering (EEE)  
Electrical Engineering Enterprise (EEEE)  
Electrical Engineering—Photonics (EEEP)  
Engineering (EBS)  
Environmental Engineering (EEN)  
Environmental Engineering Enterprise (EENE)  
Geological Engineering (EGE)  
Geological Engineering Enterprise (EGEE)  
Geology (EGL)  
Geology—Earth Science Education (EGL2)  
Materials Science and Engineering (EMSE)  
Materials Science and Engineering  
Enterprise (MSEE)  
Mechanical Engineering (EME)  
Mechanical Engineering Enterprise (EMEE)

### **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)  
Mechanical Engineering Technology—BS  
(TMET)  
Surveying Engineering—BS (TSE)

### **College of Sciences and Arts**

Anthropology (SANT)  
Applied Physics (SAP)  
Audio Production and Technology (SFAT)  
Biochemistry and Molecular Biology  
(SMBB)—Biological Sciences  
Biochemistry and Molecular Biology  
(SMBC)—Chemistry  
Bioinformatics (SBI)  
Biology—General Biology (SBL1)  
Biology—Preprofessional (SBL5)  
Biology—Secondary Education (SBL7)  
Cheminformatics (SCH1)  
Chemistry—ACS Certified (SCH)  
Chemistry—Biochemistry (SCH2)

Chemistry—Chemical Physics (SCH4)  
Chemistry—Environmental (SCH5)  
Chemistry—Polymers (SCH1)  
Chemistry—Secondary Education (SCH3)  
Clinical Lab Science 3+1 (SCL8)  
Clinical Lab Science 3+1 Cytotechnology (SCL4)  
Clinical Lab Science 4+1 (SCL9)  
Clinical Lab Science 4+1 Cytotechnology (SCL6)  
Clinical Lab Science—Secondary  
Education (SCL0)  
Communication, Culture and Media—  
Contemporary Culture (SCC4)  
Communication, Culture and Media—  
Media (SCC6)  
Communication, Culture and Media—  
Language and Diversity (SCC5)  
Computer Science—Applications (SCS1)  
Computer Science—Computer Science (SCS2)  
Computer Science—Information Systems (SCS3)  
Computer Science—Secondary Education  
(SCS4)  
Computer Science—Software Engineering  
(SCS5)  
Computer Systems Science (SCSY)  
English (SEN)  
English—Secondary Education (SEN1)  
Exercise Science (SESC)  
Fitness and Sports Management (SSFM)  
Liberal Arts (SHU)  
Mathematics—Actuarial Science (SMA6)  
Mathematics—Applied Computational (SMA8)  
Mathematics—Discrete Mathematics (SMA5)  
Mathematics—Educational Preparation (SMA9)  
Mathematics—General Mathematics (SMA2)  
Mathematics—Secondary Education (SMA7)  
Mathematics—Statistics (SMA3)

Pharmaceutical Chemistry (SCHP)  
Physics (SPH)  
Physics—Secondary Education (SPH1)  
Psychology (SPSY)  
Scientific and Technical Communication  
(BA) (STA)  
Scientific and Technical Communication  
(BS) (STC)  
Social Sciences—General (SSS)  
Social Sciences—Law and Society (SSS4)  
Social Sciences—Liberal Arts with History  
Option (SSSH)  
Social Sciences—Secondary Education  
(SSS2)  
Software Engineering (SEEN)  
Sound Design (SFSD)  
Theatre and Electronic Media Performance  
(BA) (SEMP)  
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

[www.mtu.edu/registrar/students/major-degree/minors/](http://www.mtu.edu/registrar/students/major-degree/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 Arts and Sciences

German Minor (HUG)

## 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 (HUIF)  
International German (HUIG)  
International Spanish (HUIS)  
International Studies (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)

# The University

## Cooperative Education (Co-op)

Michigan Tech encourages undergraduate and graduate students to participate in cooperative education, an experience which is essentially 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 intended to match the level of the student's training, progressing with each work assignment. Since the co-op student must complete the same academic program as a non-co-op student, the co-op student typically defers graduation by as much as a full calendar year.

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.

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

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



- Students who have previously been awarded a degree cannot have the double major designation added to their transcript.

Students planning to earn a double major should declare both majors by filing a Curriculum Add/Drop form (available in the department advising office) with the Registrar's Office and begin planning their course work as early as possible. Advisors must be identified in the departments of both majors in order to assure that the degree requirements of both are met.

## Additional Baccalaureate Degrees

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

A student enrolled at Michigan Technological University and pursuing a Baccalaureate degree can earn an additional Baccalaureate degree or degrees at the same time if they:

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

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

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

A student interested in getting an additional degree should first express their interest to the additional degree's department. A student should then complete a [Curriculum Add/Drop form](#), have their academic advisor sign it, then return the form to the Registrar's Office.

Students who have obtained a prior baccalaureate degree must complete an [Additional Baccalaureate Degree Completion Form](#) with an academic advisor from the degree-granting department.

Students pursuing two baccalaureate degrees concurrently must complete a [degree audit](#) form with an academic advisor within the additional degree's department.

## English as a Second Language Program

The English as a Second Language (ESL) Program provides instruction in English language and American culture for international students interested in pursuing a degree at Michigan Tech.

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

The SMILE Program, the Summer Intensive Language Experience, is a seven-week program offered during Session B of Summer, late June to mid August.

For more information, contact the ESL Program at [humanities@mtu.edu](mailto:humanities@mtu.edu) or call 906-487-2008.

## **Michigan Tech Online Learning**

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.

## **International Programs and Services—Study Abroad**

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

Study abroad programs at Michigan Tech can be very affordable because many of them are exchange programs. In essence, student pay their Michigan Tech tuition and exchange places with students from other countries. Financial aid and scholarships usually apply to semester and year-long programs. The Office of International Programs and Services is an excellent resource for available scholarships and grants.

Students from every discipline choose study abroad, especially considering that many courses abroad are taught in English. While knowledge of a foreign language is not necessary for many programs, living abroad is an excellent way to improve language skills.

## **MICUP Transfer Degree Program**

The Michigan College University Partnership (MICUP) Unlock Your Future Program focuses on the recruitment and support of underrepresented and economically disadvantaged community college students to academic programs at Michigan Tech. Our current community college partners are Delta College, Grand Rapids Community College, Keweenaw Bay Ojibwa Community College, and the Wayne County Community College District.

The program includes a seven-week summer university and residential experience, undergraduate research with a faculty member, and the opportunity to enroll in a 3-credit Michigan Tech course. MICUP also offers these students career explorations, tutoring, and comprehensive academic advising. If selected to attend, these and other opportunities are provided at no cost to students. A competitive stipend is granted to each participant.

For more information, contact the Center for Diversity and Inclusion at 906-487-2920 or visit our [webpage](#).

## **Officers' Training (ROTC)**

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

## **Preprofessional Programs**

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

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, or 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)
- 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)

# Admissions—Getting In

## Application Procedure

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](#).
3. Prospective First-year Students: ask your high school guidance office to send your official transcript, official ACT and/or SAT scores, and the high school counselor information page directly to the Michigan Tech Admissions Office.
4. Prospective transfer students: submit application and official transcripts from all colleges attended to the Michigan Tech Admissions Office.
5. Prospective international students: see [Admissions Procedures](#).

## 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 various 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](#)).

- **Application Forms**—Applications may be obtained from the Michigan Tech Admissions Office or [online](#).
- **Credentials**—Materials to accompany the application include the official high school transcript(s) and the optional high school counselor information page. Transfer students must submit official transcripts from all colleges attended.
- **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](#)
  - [ACT](#)

**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](#) 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 can 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

## Application Procedure

1. Apply [online](#) (recommended) or submit an application to the Michigan Tech Admissions Office. A pdf copy is available online.
2. Ask your high school guidance office to send the following documents directly to the Admissions Office:
  - a. Official transcript (showing grades through your junior year)
  - b. Official ACT and/or SAT scores
    - i. If your test scores are not included on your official transcript, you may have them sent directly to Michigan Tech by providing the appropriate school code to the testing agency (ACT code is 2030; SAT code is 1464).
  - c. [High school counselor information page](#)

## 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, Additional Materials, 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 to three weeks.

## Transfer Applicants for Admission

Students in good standing who have satisfactorily completed work at another college or university may apply for transfer admission.

### Application Procedure

1. [Apply online](#) (recommended) or submit an application to the [Michigan Tech Admissions Office](#). A pdf is available online.
2. Have all colleges attended submit official transcripts directly to the Admissions Office.
3. Transfer students who have earned fewer than 30 credits at the time of application must submit an official copy of their high school transcript showing date of graduation. The transcript must be sent directly from the high school.

### GPA Recommendations

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.

## Transfer credit

Transfer credit is granted in accordance with the guidelines established by the academic departments.

- **Specific or approved course credit** is granted for courses taken (including online courses) in which passing grades of C (2.00 on a 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.
- **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. 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.

## Homeschooled Students

Michigan Tech welcomes homeschooled students to apply for undergraduate admission. A student may apply while final course work is still in progress.

## Application Procedure

1. [Apply online](#) (recommended) or submit an application to the [Michigan Tech Admissions Office](#). A pdf is available online.
2. Submit all required supporting materials:
  - a. 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 can be parent or instructor generated.
  - b. 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 therefore not acceptable.
  - c. College transcripts, if any college-level course work has been taken
  - d. Official final high school transcript indicating date of graduation

## International Students

### Admissions Criteria

International Graduate Students

Masters and Ph.D. students must apply for admission through the [Graduate School](#). There is no application fee.

International First-Year, Exchange, Transfer and ESL Students

Apply [online](#). There is no application fee.

### International Undergraduate Admissions Procedure

1. Complete the Michigan Tech Application for Admission any time up to one year before you plan to enroll. You may apply online or use our PDF admission application form. If you use the PDF form, it must be completed electronically, printed, and mailed to the IPS office.
2. Send all other required documents.
3. Satisfy US embassies' requirements for visa issuance, including certification of financial support.
4. Information, including a checklist and all necessary forms can be accessed at our website.

Michigan Technological University's English as a Second Language program is intended for students planning to earn a degree from Michigan Tech.



Note: Students who do not meet our minimum English language requirement may be admitted as ESL students. This includes all students who have been offered conditional admission.

### **Preferred Application Deadlines**

While there is no application deadline—applications are accepted on a rolling basis—we recommend that students follow the guidelines below:

Completed applications for admission for fall semester are due by April 15.

Completed applications for admission for spring semester are due by September 15.

Completed applications for SMILE: Summer Intensive Language Experience for students outside of the US are due by March 12.

Completed applications for SMILE: Summer Intensive Language Experience for students from Canada, Mexico, or those currently in the US are due by May 15.

Incomplete applications will be considered for admission the following semester.

### **Admitted International Students**

An applicant is admitted to Michigan Tech only when he or she has submitted all application materials 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.

Based on the required orientation schedule and the schedule of the Housing Office and Dining Halls, IPS recommends that you plan to arrive in Houghton as close as possible to the check-in date. We would like you to read and use the Pre-Arrival Information to plan and prepare for your travel to and stay at Michigan Tech. Pay special attention to the instructions for submitting your arrival information. Upon arrival to Michigan Tech's campus, accepted international students must report to the International Programs and Services (IPS) Office.

### **Enrollment Deposit**

First-year and transfer students are required to pay a \$100 Enrollment Deposit to secure course registration and housing assignments. So that we may properly plan for your arrival, we ask that you submit the deposit no later than 2 months before your intended term. Housing and course registration priority will be granted to students who submit the enrollment deposit.

## **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.

To apply for guest-student admission, submit a Michigan Uniform Undergraduate Guest Application form to the [Michigan Tech Admissions Office](#). The form may be obtained from the [Admissions Office](#) or from any other college or university in Michigan.

## **Nondegree Students**

### **Application Procedure**

[Apply online](#) (recommended) or submit an application to the Michigan Tech Admissions Office. A pdf is available online.

**Nondegree-seeking** students are not required to submit high school or college transcripts with their Application for Admission. However, if a nondegree-seeking student later desires to become degree seeking, 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 through the dual enrollment program with the permission of their high school.

## **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 and requests to reenter the University must submit [a written petition](#) to the Dean of Students Office prior to the semester for which the student requests readmission. Please see [www.admin.mtu.edu/dos/reinstate](http://www.admin.mtu.edu/dos/reinstate)

## **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 2–3 weeks.

**Acceptance Packet**—Upon acceptance to Michigan Tech, students receive information regarding the steps necessary to enroll as well as details about the enrollment deposit, course selection, housing and dining options, and orientation.

# Finance 101

## Basic Expenses

- [Tuition Rates Past and Present](#)
- [Room and Board](#)
- [Michigan Tech Apartment Rates](#)
- [Payments](#)

## Applying for Financial Aid

### ***University Merit-Based Awards***

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 <http://www.mtu.edu/finaid/types/scholarships/> for application requirements). 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).

### ***Federal and State Aid***

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](http://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 FAFSA.

### ***Financial Aid Package***

Once you've completed your FAFSA and provided the requested information, we can prepare your financial aid package, which is the total amount of aid offered to you by the University. Your package will include need-based scholarships, grants, loans, and/or work-study opportunities for which you are eligible. Prospective students will receive their packages in mid-March. Current students will receive their packages in late July. At that time, you may accept or decline any financial aid in your package.

### ***Awarding 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 Aptitude 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 students having completed two full-time semesters at any college or university. Recipients of new transfer awards are selected on the basis of college academic record. Students should apply to Michigan Tech by January 15 of the academic year preceding their intended term of enrollment.

**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 late July.

## Scholarships/Grants

Michigan Tech offers scholarships sponsored by the University, individuals, companies, and by local, state, and federal agencies. The following list is not inclusive; for a complete list of scholarships and more information on application procedures, visit the Financial Aid [website](#).

**Michigan Tech Leading Scholar Awards**—Michigan Tech's premier scholarship program is merit based and awarded to US domestic residents who are members of the current year's graduating high school class. Three Michigan-resident students will be awarded scholarships equivalent to regular full-time tuition, plus room and board, and a stipend of \$1,000 each year. In addition, twenty-seven Michigan-resident students will receive \$8,000 per year. Three out-of-state students will receive a value equivalent to regular full-time, out-of-state tuition. In addition, seven out-of-state students will receive \$17,000 per year. Candidates must be recommended for the award by a high school teacher by mid-October of their senior year. Nominees' applications for admission must be postmarked by October 15. The awards are renewable for four years (eight semesters). Recipients must maintain a minimum 3.25 cumulative grade point average to have the award renewed for the second, third, and fourth years. Recipients receiving an \$8,000 or \$17,000 scholarship must maintain a minimum cumulative GPA of 2.50 for renewal.

**Presidential Scholars Program**—These merit-based awards, which can be used for any baccalaureate curriculum, vary from \$1,000 to \$4,000 and support Michigan residents who are members of the current year's graduating class from Michigan high schools.

**Michigan Tech Transfer Scholarship**—These merit-based awards, which can be used for any degree curriculum, support new incoming undergraduate transfer students who are Michigan residents and who have attended any college or university for a minimum of two semesters. The award values range from \$1,500 to \$3,000.

**Michigan Tech Merit Scholarships**—These merit- and need-based awards, which can be used for any baccalaureate curriculum, support US citizens who are members of the current year's graduating high school 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**—These merit-based awards, which can be used for any degree curriculum, support citizens or residents of countries outside the United States. The value ranges from \$1,500 to \$6,000.

**National Scholars Awards**—These merit-based awards support 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 \$12,500. 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-student award values range from \$4,000 to \$7,000.

**University Student Awards**—This program is designed to provide financial assistance to incoming and current students at Michigan Tech. Awards are made based on academic potential and financial need. The amount of each award is variable, depending upon need. Michigan residents may be awarded up to the amount of full-time, in-state tuition. Students paying nonresident rates may be awarded an amount up to the difference between Michigan-resident tuition and nonresident tuition. Recipients of this award must attend full-time, reapply each year, and meet the required minimum 2.00 cumulative GPA.

**Summer Youth Diversity Incentive Award**—These awards support Michigan and non-Michigan residents who are incoming first-year undergraduate students. Awarding for the scholarship will have both merit-and need-based considerations. Recipients must have participated in a Summer Youth academic program at Michigan Tech. The scholarship values range from \$1000 to \$4000 a year. For application details, visit the Financial Aid website.

**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 typically cover partial tuition up to full tuition plus lab fees. Scholarship students also receive \$900 per year for books. A \$300 to \$500 monthly tax-free allowance is provided to all contracted cadets. High school students must apply for the scholarship by December 1 of their senior year at [www.afrotc.com](http://www.afrotc.com). Interested college students with three or more years remaining to complete their degrees may be eligible for In-College or Express Scholarships and should stop by the ROTC building to learn more about these opportunities. Students should contact the [Air Force ROTC Department](#) at 906-487-2652 or [rotcinfo@mtu.edu](mailto:rotcinfo@mtu.edu).

- The US Army ROTC (Department of Military Science) offers its cadets scholarships that pay full tuition, fees, and \$1,200 in books per year. Scholarships are offered to first- through third-year students and are available for up to a total of five years to allow for completion of 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. 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. Students should contact the Army ROTC Department at 906-487-2650 or visit our [website](#).

**Summer Youth Diversity Incentive Award**—These awards support Michigan and non-Michigan residents who are incoming first-year undergraduate students. Awarding for the scholarship will have both merit-and need-based considerations. Recipients must have participated in a Summer Youth academic program at Michigan Tech. The scholarship values range from \$1000 to \$4000 a year. For application details, visit the Financial Aid [website](#).

## 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 \$5,550 for 2011-2012. A Pell Grant does not have to be repaid.

**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.

**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 \$27,500. 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.

**Federal Work-Study Program**—This program, based on financial need, provides assistance through employment on campus. Every effort is made to place students in jobs related to their skills, interests, and fields of study. Work-study participants receive biweekly paychecks and are generally employed eight hours per week.

**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 from the coordinator of 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**—Need-based assistance 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.

Scholarships	12
Federal Perkins Loan or Tech Aid	6
Federal SEOG	6
Federal Pell Grant—minimum current criteria or more	
Full grant	12
Three-quarter-time grant	9–11.5
Half-time grant	6–8.5
Less than half-time grant	0.5–5.5
University Student Award	12

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

**Satisfactory Progress Policy**— Federal financial-aid regulations require that a student must make satisfactory progress to remain eligible for financial aid. Financial aid programs affected by this policy are Federal Pell Grant, Federal Perkins Loan, Federal Work-Study, Federal Supplemental Educational Opportunity Grant, Federal Direct Subsidized Loans, Federal Direct Unsubsidized Loans, Federal Direct PLUS Loans, Michigan Competitive Scholarships and Michigan Tuition Incentive Program (TIP).

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 Dean of Students Office.

## 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 Dean of Students Office. 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 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, provost and vice president for academic affairs, 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 safety first alert, the University web site, and local media. Faculty and students will be excused from reporting to class.

# Academic Preparation

## Advising

Upon enrollment, students are assigned academic advisors by their major departments. Students are urged to consult their advisors regarding all academic concerns.

## Orientation

Orientation is an informative program designed to introduce new students to academic life, campus, and their classmates. Attendance at the weeklong Orientation program is required for all new first-year students. Transfer students with more than 30 credits attend a one-day Orientation program or complete an online program. During Orientation, students will learn about campus resources, University policies, 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 other students, to become familiar with their new community, and to attend programs regarding the academic and social transitions to college life.

## **Learning Centers**

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, business and economics, chemistry, civil and environmental engineering, computer science, electrical and computer engineering, forestry, mathematics, mechanical engineering, multiliteracies (writing), and physics.

## ExSEL (Excelling the Student Experience of Learning)

ExSEL is designed to promote student success and encourage leadership development. Housed in the Center for Orientation, Mentoring, Parents, and Academic Student Success (COMPASS), 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 Dean of Students Office [online](#).

**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:

3.9–4.0 *Summa Cum Laude* (highest honors)

3.7–3.89 *Magna Cum Laude* (high honors)

3.5–3.69 *Cum Laude* (honors)

## Academic Difficulty

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

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

**Academic Probation**—Students who are not making satisfactory progress toward a degree are placed on academic probation. Academic probation is a strong warning to students that their scholastic performance is less than that expected by the University. Notices of academic probation are sent to students at the same time grades are available at the end of the semester. Failure to improve after receiving a probation notice can result in academic 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 reenroll until the following spring. Upon receiving a second notice of academic suspension, a student must sit out two semesters, plus a summer. Upon reinstatement after a second suspension, failure to achieve good academic standing or show substantial academic progress within one semester will result in academic dismissal. There is no opportunity for reinstatement after academic dismissal.

**Appeals of Academic Suspension/Dismissal**—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 students. A convenient petition form can be found [online](#).

**Reinstatement**—A student suspended for unsatisfactory academic progress may apply for a reinstatement through a written request to the dean of students after a period of nonenrollment. 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 reenrollment. A convenient petition form can be found [online](#).

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

## Academic Renewal

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

The following conditions apply in cases of Academic Renewal:

1. A student enrolling at Michigan Tech after an absence of five (5) years or more may elect Academic Renewal. This renewal will affect only those courses taken prior to the five (5) year absence and may be elected only once. Academic Standing will be initialized to 'Good Standing' for students electing Academic Renewal.
2. Academic Renewal is open only to undergraduate students admitted into a degree program. Academic Renewal is forfeited if a degree program is not completed.
3. Academic Renewal must be invoked prior to graduation and is not available to students who have previously completed requirements for a Michigan Tech Bachelor's or Associate's degree.
4. If more than one term is elected for Academic Renewal, the terms must be consecutive and have been completed within a maximum of two (2) calendar years for Bachelor's degrees or one (1) calendar year for Associate's degrees.
5. A student receiving a Bachelor's or Associate's degree from Michigan Tech must meet the University residency for graduation requirement in the interval between the most recent course work elected for renewal and the completion of courses at Michigan Tech.
6. To qualify for Academic Renewal, a student must have an overall GPA below 2.0 for the renewal period.
7. Renewal will apply to all courses taken during the period for which it is elected regardless of the grade earned. No course credit is granted for any courses in Academic Renewal terms. Academic Renewal courses are not subject to the existing Repeat Policy rules.
8. All courses and grades in Academic Renewal terms will remain on the student's transcript with a notation that "Academic Renewal has been granted". All grades will be annotated with an 'R' indicating Renewal, e.g. RD or RF. Grades thus annotated will be excluded from University grade point average computation.
9. Academic renewal is a policy of Michigan Technological University. As such, students should be aware it may not be recognized by outside institutions or agencies.
10. Once elected, Academic Renewal is irrevocable. Students must consult with their academic advisor prior to election of Academic Renewal. Signed application forms will be processed and retained by the Registrar's Office.

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 Dean of Students Office. Requests are evaluated on a case-by-case basis.

## Conduct

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 Dean of Students.

**Substance Abuse**— The University encourages and promotes an environment where healthy lifestyle choices can be made every day by students, faculty, and staff. Students may obtain substance abuse consultation and counseling through Counseling 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" available in the Dean of Students Office or [online](#).

## 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 without discrimination. Students with documented disabilities should contact the Dean of Students Office/Coordinator of Student Disability Services (SDS) for assistance and accommodations. It is the student's responsibility to contact the Coordinator of SDS at the beginning of each semester during which he or she wishes to have accommodations.

## 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.

## 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. Also used for Graduate Research courses.
- Q (inadequate progress)—may be used for approved 3000- or 4000-level project courses where projects carry over for more than one semester. Also used for Graduate Research courses.
- 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 with the academic advisor for each academic program in which enrolled.

## Undergraduate Commencement Eligibility Requirements

Michigan Tech conducts two commencement ceremonies each year that are held in the spring and fall semesters. Students completing all degree requirements in the spring or summer will be listed for the spring commencement ceremony and students completing their degree requirements in the fall will be listed for the fall commencement ceremony. Students who find it necessary to participate in a ceremony held prior to their graduation term due to extenuating circumstances must seek approval from the 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 program requirements.
- Have an approved audit on file with the academic advisor for each academic program in which enrolled.
- Submit any petitions to alter curriculum requirements at least two semesters prior to expected graduation term.

- Have an application for graduation on file for each degree and certificate in which enrolled in the Degree Services Office two semesters prior to the expected graduation term.

\*\*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. These rights include:

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

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

2. The right to request the amendment of the student's education records that the student believes are inaccurate, misleading, or otherwise in violation of the student's privacy rights under FERPA.
  - a. A student who wishes to ask the University to amend a record should write the University official responsible for the record, clearly identify the part of the record the student wants changed, and specify why it should be changed.
  - b. If the University decides not to amend the record as requested, the University will notify the student in writing of the decision and the student's right to a hearing regarding the request for amendment. Additional information regarding the hearing procedures will be provided to the student when notified of the right to a hearing.
3. The right to provide written consent before the University discloses personally identifiable information from the student's education records, except to the extent that FERPA authorizes disclosure without consent.
  - a. The University discloses education records without a student's prior written consent under the FERPA exception for disclosure to school officials with legitimate educational interests.
  - b. A school official is a person employed by the University in an administrative, supervisory, academic or research, or support staff position (including law enforcement unit personnel and health staff); a person or company with whom the University has contracted as its agent to provide a service instead of using University employees or officials (such as an attorney, auditor, or collection agent); a person serving on the Board of Trustees; or a student serving on an official committee, such as a disciplinary or grievance committee, or assisting another school official in performing his or her tasks.
  - c. A school official has a legitimate educational interest if the official needs to review an education record in order to fulfill his or her professional responsibilities for the University.
4. The right to file a complaint with the US Department of Education concerning alleged failures by the University to comply with the requirements of FERPA. The name and address of the office that administers FERPA is Family Policy Compliance Office, US Department of Education, 400 Maryland Avenue SW, Washington, DC 20202-5901.

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

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

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

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

Questions about FERPA may be directed to Michigan Technological University, Registrar’s Office, 1400 Townsend Drive, Houghton, MI 49931-1295. The complete policy is available on the [Registrar’s Office website](#).

## University Information and Freedom of Information Act

Michigan Tech is committed to maintaining a free exchange of information throughout the University community. It is our general practice to release most types of information immediately upon request.

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

## Registration

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

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

The Schedule of Classes can be found on the web at [Prepare for Registration](#).

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

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

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

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

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

During the first three weeks of a semester, courses dropped will not be recorded on the student’s permanent record. Beginning the fourth week through the end of the 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 Dean of Student's Office which will consider only those requests that clearly involve extenuating circumstances beyond a student's control. The course will appear on the student's transcript with a grade of W.

NOTE: Students who drop all of their classes will be withdrawn from school as of the date those classes were dropped.

**Financial Obligations**—Having fulfilled all other requirements, a student is eligible for registration or graduation only if all financial obligations to the University have been met. Students with an outstanding balance will have a hold placed on their account. This hold denies access to registration and prevents the distribution of grades and transcripts.

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

**Prerequisites**—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.

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

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

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

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

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

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

[Download](#) Curriculum Add/Drop form.

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

A Senior Rule form must be completed and submitted to the Registrar's Office 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

Looking to get involved? Well, you found the right place! Student Activities, 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 us at [activities@mtu.edu](mailto:activities@mtu.edu). Student Activities consists of: Greek Life, Leadership, Registered Student Organizations (RSO), Community Service, the Outdoor Adventure Program (OAP) along with Campus Programs & Traditions. We look forward to meeting you!

### [Student Organizations](#)

More than 200 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. For a full listing of the current registered student organizations please see: [www.involvement.mtu.edu](http://www.involvement.mtu.edu).

K-day, the Spring Involvement Fair and Spring Fling events are excellent times to learn more about student groups.

### [Undergraduate Student Government \(USG\)](#)

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**

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 dismissed at noon so that students and faculty can celebrate and participate in the activities.

### **Parade of Nations**

The Parade of Nations, held in September, celebrates diversity with a colorful parade, complete with floats, bands, and flag-bearing students representing our students' nations. Following the parade, students, faculty, and members of the community gather at the Multicultural Festival for a celebration of food, culture, music, and dance.

### **Homecoming**

Few homecoming festivities on any campus can rival Michigan Tech's for zaniness and all-around fun! In addition to the football game and the crowning of the homecoming king and queen, the celebration features a parade, a cardboard boat race, competitive challenges, and many other events to promote Husky spirit.

### **Family Weekend**

Each fall semester, parents and families are invited to the Keweenaw Peninsula on Family Weekend to explore campus, attend cultural events, cheer the Husky teams to victory, and tour the Copper Country to see its vibrant fall color. Family Weekend is a time for parents to visit with their Tech student, experience university life, and create fond family memories at Michigan Tech. Visit the [Family Weekend](#) website for dates and specific event information.

### **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 carved by students, 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! Winter Carnival is held in early February during a two-day class break.

## Spring Fling

Spring Fling is a recognized University Tradition and is always the Friday of Week 13 of the Spring Semester. Student groups gather on campus for food, music and fun as they usher in the beginning of spring and celebrate the end of the school year. Sponsored by the Memorial Union Building Board.

## Visual and Performing Arts

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. Students play significant roles as managers, designers, production staff, and performers, working side by side with the faculty in art, music, and theatre. Opportunities for students include:

- **Music**—Students, faculty, and community residents participate in musical ensembles, including Concert Choir, Superior Winds 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**—Each season 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 sponsors the Great Lakes Showcase, an exhibition for professional artists.

## 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, but also provides our students with numerous educational and practical opportunities for hands-on experience in backstage and front-of-house crews.

## Athletics

### Intercollegiate Athletics (NCAA)

[Intercollegiate Athletics \(NCAA\)](#)—Michigan Tech, with its rich tradition in intercollegiate athletics, currently competes in 14 sports: Division I men's ice hockey and Division II football, men's and women's basketball, women's volleyball, women's soccer, men's and women's tennis, men's and women's cross country, men's and women's track and field, and men's and women's Nordic skiing.

The tradition of Huskies' success includes three national championships by the ice hockey team, a national third-place finish by the women's basketball team and dozens of conference titles along the way. Every team sport has reached the NCAA Tournament level during the last decade, and numerous athletes from the individual sports have advance to the NCAA Championships in that time frame.

### [Intramural-Recreational Sports Services Department](#)

The Intramural-Recreational Sports Services department provides a wide variety of recreational activities that appeal to the leisure-time pursuits of students, faculty, and staff.

We encourage that participation be for 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 Tech.

## [Recreational Facilities](#)

The University owns and operates multiple athletic facilities and recreation areas for the benefit of its students, faculty, and staff. Recreational areas are available for badminton, baseball, basketball, bowling, football, golf, hockey, ice-skating, mountain biking, racquetball, skiing, snowboarding, soccer, running, swimming, tennis, volleyball, and weight lifting—whatever your exercise, your passion, or your diversion, Athletics and Recreation at Michigan Tech can help.

### **Student Development Complex (SDC)**

A 235,000-square-foot, indoor sports arena located on the Michigan Tech campus. Current students may use the facilities free of charge. The SDC features the following:

- basketball, volleyball, and badminton courts
- climbing wall
- dance room
- fitness center
- ice arena
- locker rooms with showers and saunas (towel service available for minimal fee)
- racquetball, squash, and wally ball courts
- rifle range
- running track
- sports equipment rentals
- swimming pool and separate diving tank
- varsity gym
- University Images (Michigan Tech apparel shop)

Areas just outside the SDC include a disc golf field, a football field (Sherman Field), sand-volleyball courts, soccer fields, and softball fields.

### **Gates Tennis Center**

An indoor tennis facility located near the SDC that features the following:

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

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

#### [Michigan Tech Trails](#)

Nordic Ski Trails & Recreational Forest--A trail system located across the street from the Student Development Complex.

- 675 acres
- 7 km of lighted ski trails
- 33 km for groomed skiing
- 11.7 km for groomed snowshoeing
- 43 km for biking
- 11.7 km of dog-allowed trails
- 55.6 km for hiking and running

Cross country ski and snowshoe equipment rentals for the trails are available at the SDC Ticket Office.

#### [Mont Ripley Ski Hill](#)

Mont Ripley Ski Hill is owned and operated by Michigan Tech and is located two miles north of Houghton., across the Portage Canal in Hancock. Mont Ripley is part of the Experience Tech Fee. To access the hill, just show your student ID and receive your daily ticket. Mont Ripley features:

- Over 100 acres of terrain
- Over a hundred day season
- Night skiing 7 days a week

- PE classes
- Multiple terrain parks
- Chalet with a cafeteria
- Season lockers
- Ski and snowboard rentals for the day or season
- Pro shop

### [Portage Lake Golf Course](#)

The only 18-hole golf course in the Keweenaw. Located three miles south of Houghton, it features the following:

- Online reservations
- Merchandise
- Adult & Junior Lessons
- Men's, Women's, Junior & Student Leagues
- Bar & Grill
- Practice Facilities
- Rental Carts & Clubs.

## Health Care

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

[Portage Health](#) also operates an Express Care service in Houghton (906-483-1777) as well as an after-hours walk-in clinic and hospital emergency care at 500 Campus Drive, Hancock, (906-483-1000).

**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 the [Student Insurance page](#).

## Housing

**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 apply to 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 for the following academic year, provided 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 an 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 alcohol-free housing areas and the Learning Communities.

**Alcohol-free** housing is offered in all three of the 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 Computer Science Learning Community (CSLC) consists of students who share academic interests in the field of Computer Science. The CSLC is geared towards students majoring in Computer Science, Software Engineering, and Computer Systems Science. This community brings together students, staff, and faculty who share a passion for computers and computer related technology. Through various programs and activities, CSLC students will have the opportunity to get involved, make friends, and study and learn together in a supportive environment.
- **Forest Resources and Environmental Science Learning Community (FRES)**—The Forest Resources and Environmental Science (FRES) Learning Community combines academics and an appreciation for the natural world. This close-knit community is designed for students seeking degrees in forestry, applied ecology and environmental sciences, and wildlife ecology and management. Students in the FRES community benefit from interactions with faculty inside and outside the classroom as well as numerous fun social activities in the FRES community.
- **First Year Experience (FYE)**—As a member of the First Year Experience (FYE) Learning Community, you have the unique opportunity to live in a community with other first-year students and experience Michigan Tech together for the first time. FYE helps make your transition to college easier by providing extra peer staff and numerous opportunities to get to know others in the residence halls and the Michigan Tech community. FYE emphasizes a community atmosphere where everyone works together to build and develop a positive community that is not only fun, but also is one that promotes success in academics as well.
- **The Summit**—The Summit Learning Community is all about the wellness of the mind, body, and spirit. In Summit, you can focus on academic success in an alcohol-free environment with others who are interested in living an active lifestyle. In Summit the staff and students recognize that wellness and success is different for each student, so you will have opportunities to participate in a variety of fun programs that revolve around intramural sports, outdoor activities, campus traditions, and so much more.
- **Global Village**—Global Village is an inclusive global community that encourages and welcomes individuals who want to learn about other countries, cultures, and people. Whether you are thinking of possibly studying abroad in the future, or if you just want to live and learn with a group of people with diverse backgrounds, Global Village will be a great fit for you. In addition to the many fun activities and programs, this Learning Community works with International Programs and Services (IPS) to make sure that students are aware of the great opportunities and support available to them during their time at Michigan Tech.
- **Leadership Learning Community (LLC)**—The Leadership Learning Community (LLC) is a community where students will learn about and develop leadership and are encouraged to put their skills into practice. Here, you can learn what kind of a leader you are and how to incorporate and balance leadership in your everyday life. In this team environment, you can develop your skills and take advantage of the countless opportunities Michigan Tech offers to advance as a leader even further.
- **Visual and Performing Arts Learning Community (VPALC)**—The Visual and Performing Arts (VPA) Learning Community is designed for anyone interested in the arts (music, dance, graphic design, photography, theater, etc). In the VPA community, you will have plenty of opportunities to get involved and get to know others through a variety of programs and activities. Students in the VPA Learning Community also have unique opportunities to build relationships and network with talented and experienced departmental staff, faculty, and other students who share these interests and passions.
- **Women In Engineering**—The Women In Engineering Learning Community brings together female engineering students and provides support as they pursue careers in the field of engineering. This close-knit community offers a team-oriented atmosphere for women who want to be successful in their academics while also enjoying everything Michigan Tech has to offer. Students in the WIE community will enjoy extra faculty interaction, opportunities to network and get involved with the Society of Women Engineers (SWE), and a wide array of fun programs and activities.

### [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. [Dining Dollars](#), which allow students the flexibility to eat outside the residence dining halls at campus retail locations, may be added to a meal plan. The Platinum, Gold and Silver Plans include \$300, 150 and \$100 respectively in Dining Dining Dollars per semester.

### **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**

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, 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, a sand volleyball court, high-speed computer access, an activity room, bike storage, and free bus service between the apartments and the main campus during the regular academic year. For more information please visit:

<http://www.mtu.edu/housing/apartments/daniell-heights/>

Newly opened fall 2010, Michigan Tech will opened a 195-bed residential apartment building called the Hillside Place located in the on-campus residential community. Amenities will include a cleaning service twice per month, gender-neutral housing, Internet, cable, phone, air conditioning, and in-floor heating. For more information please visit:

<http://www.mtu.edu/housing/apartments/hillside-place/>

### **Off-Campus Housing**

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. To assist students in locating off-campus housing, Undergraduate Student Government (USG) maintains a list of off-campus householders renting to students; this list is available from the Student Organizations office, in room 106 of the Memorial Union Building, or [online](#).



## Support Services

### [Career Center](#)

Career Services 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 presentations, and a career-guidance software program. All services are free to Michigan Tech students and alumni.

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

Students are also encouraged to attend the semiannual on-campus job fairs sponsored by Michigan Tech. Career Fairs provide students with one of the best opportunities to obtain co-op, summer-internship, and permanent-employment positions.

Visit the [Career Services' website](#) for a complete description of the numerous services and benefits that are available.

### [Child Care](#)

Little Huskies Child Development Center is accredited by The National Association for the Education of Young Children. It is located on campus between the Gates Tennis Center and the U. J. Noblet Forestry Building on MacInnes Drive. Little Huskies research based curriculum 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 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 the center's director, Eva-Marie Hatfield, at 906-487-3528.

### [Counseling and Wellness Services](#)

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 providing 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 & Wellness Services also contracts with Portage Health so that students have access to a nurse practitioner who can prescribe and/or coordinate the student's medication and prescription needs with their physician or psychiatrist.

Counseling and Wellness Services also offers wellness education resources. HOWL (Healthy Options for a Wellness Lifestyle) students provide work-shops, presentations, and programming related to several health and wellness topics. Any group of students on campus can request a presentation or work-shop in any area of interest by contacting HOWL.

Counseling and Wellness Services is located in the Administration Building, room 301. All services are confidential and free of charge for students. To make an appointment, call 906-487-2538 during regular business hours (Monday-Friday, 8:00 a.m.-5:00 p.m.). To request a workshop or presentation, call 906-487-2538 or email [wellness@mtu.edu](mailto:wellness@mtu.edu).

## **International Programs and Services (IPS)**

The Office of International Programs and Services (IPS) is the key resource for international initiatives and programs at Michigan Tech. IPS offers 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, IPS provides transition services to over 900 international students and scholars at Michigan Tech, including counseling, advocacy, and support services. IPS significantly contributes to the internationalization of Michigan Tech and Upper Peninsula communities by sponsoring multiple cultural and educational programs, including the Parade of Nations, New International Student Orientation, and informational workshops. IPS also offers intercultural-communication training for the campus community.

## **Center for Diversity and Inclusion**

### **Mission Statement**

The Center for Diversity and Inclusion provides support and development that enriches the intellectual, social and professional growth of Gay, Lesbian, Bisexual and Transgender (GLBT) students, students of color, and women. The Center for Diversity and Inclusion assists Michigan Technological University with the recruitment, retention and successful graduation of underrepresented students.

### **Our Vision**

The Center for Diversity and Inclusion is a resource for preparing and empowering socially conscious leaders to create the future.

### **About Us**

The Center for Diversity and Inclusion offers workshops and programs that focus on multicultural, diversity social justice. The Center for Diversity and Inclusion provides academic, personal, educational and support programs for students.

Contact the Center for Diversity and Inclusion at [diversitycenter@mtu.edu](mailto:diversitycenter@mtu.edu), at 906-487-2920, or visit our [website](#).

## **Information Technology (IT)**

The Office of Information Technology (OIT) 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. The OIT also manages the network and user support for ResNet (network connectivity in the residence halls and student apartments.)

User support for any issues related to IT may be obtained by calling User Services at 487-1111, by sending an e-mail to User Services at [it-help@mtu.edu](mailto:it-help@mtu.edu), or by stopping by one of the User Services Help Desks on campus. For further information, visit [www.it.mtu.edu](http://www.it.mtu.edu)

## **Student Affairs Office**

The Office of Student Affairs 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](#)

The Van Pelt and Opie Library is the heart of campus for study, collaboration and innovation with an array of people and services to help you navigate through the worlds of academic information and technologies. Librarians and staff stand ready to assist students, on-site and virtually, with research, projects and course assignments.

Study and connect wirelessly in the beautiful 24 hour-accessible reading room, work together in 22 study rooms, instructional classrooms and a variety of open spaces and nooks – there are vibrant or quiet options to suit your study preferences. A growing digital annex provides resources, assistance and tools for your digital projects.

Time-saving and convenience services include a help desk offering one-stop services to support your information technology and information services questions and needs, check-out of tools including laptops and cameras, and a café with coffee, sandwiches and snacks.

The library contains 800,000 physical publications such as books, journals, US and Michigan government documents and a vast archive of print, manuscript and graphic resources covering the history of the university and of the western Upper Peninsula region. Access to thousands of e-journals, e-books and other digital resources, including the [Keweenaw Digital Archives](#), a photographic history of the Copper Country is available on or off-campus.

Check out the [online help](#) desk to connect to us and search [online](#) for resources using the catalog, databases for finding articles and e-journals and librarian-created, time-saving guides offering starting points for many courses and broad disciplines. Visit the library and tell us how we can help. We are committed to your success at Michigan Tech.

### **A.E. Seaman Mineral Museum**

The 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 will be partially reopening July 5th, 2011 in their new facility with exhibits being progressively opened to the public as completed. The museum is now located at 1404 Sharon Avenue in Houghton (corner of Sharon and Garnet across from the softball fields). Hours are Monday to Saturday 9:00am-5:00 pm July 5th through December 2011. January 2012 through April the museum is only open Wednesday through Saturday, 10:00am-5:00pm, and then in May resumes the Monday to Saturday 9:00am - 5:00pm hours.

# General Education

## General Education Goals

The goals of General Education, a required component of every Michigan Tech degree, include developing in each student

- fundamental scholarly habits, including careful reading, effective communication, critical reasoning, balance, analysis, and argumentation.
- 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 their major.

## General Education Curriculum

The General Education curriculum consists of the following requirements:

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

## General Education Advising

General Education requirements are not normally waived, substituted, or modified. Advisors may submit such requests if students have received incorrect advice. Requests are reviewed on an individual basis by Helene Hiner or Brad Baltensperger for the General Education Executive Committee.

**Core Courses (13 credits)** The core courses are designed to promote active engagement in learning, coherence within the curriculum, integration within and across disciplines, strong communication abilities, and development of university-level habits of mind.

*Perspectives on Inquiry* (UN1001) – 3 credits. This first-year seminar course is required during each student's first year at Michigan Tech. Most sections are taught in fall semester, including special sections for Honors students. The few sections during spring semester are open to transfer students, newly-arrived students, and a select number of other first-year students.

*World Cultures* (UN1002) – 4 credits. This required course is taught primarily during spring semester in large lecture sections.

*Modern Language Option for World Cultures* (UN1002)

Two semesters of a modern language taken at Michigan Tech along with UN 1003 World Cultures lab may be substituted for UN1002. UN1003 is only taken by students concurrently enrolled in modern language. Students may begin their two semesters of modern language in the fall or spring semesters of their first year. Students with transfer or AP language credit, or who plan to study abroad, should see the humanities department modern language director for advice. The two semesters of language and UN1003 meet the requirement for UN1002 plus 3 credits of Distribution/HASS for a total of 7 credits.

**Transfer credit for UN1001 and UN1002:** Two core courses, UN1001 [Perspectives on Inquiry](#) and UN1002 World Cultures, may not be taken off-campus once a student is enrolled at Michigan Tech. There are acceptable transfer courses for incoming transfer students (not yet enrolled at Michigan Tech) for these courses.

*Revisions* (UN2001) – 3 credits. This writing-intensive course is to be taken in the student's second year at Michigan Tech.

*Institutions* (UN2002) – 3 credits. The course is to be taken in the second year.

**Transfer credit for UN2001 and UN2002:** Students are permitted to transfer courses from other institutions to satisfy the Revisions and Institutions requirements. Students must check with the Michigan Tech Transfer Services Office to find out which courses qualify before a class is taken off-campus.

**HASS Requirement for students enrolled Fall 2008 and later (15 credits)**

Humanities, Arts, Social Sciences (HASS) 2008 Fall

[HASS Distribution List](#)

**Distribution Courses for students enrolled BEFORE fall 2008 (15 credits)**

[Distribution Requirement](#) (list for students entering before Fall 2008)

Students must take six credits from each list World Cultures and Institutions (see **Distribution Courses**). The final three credits can come from either list. *A number of 2000-level distribution courses, marked with an asterisk, are designated as courses that can be taken during the first year in the same term as Perspectives on Inquiry and/or World Cultures.*

Note the following restrictions:

- If a course is labeled “activities,” a student may apply no more than three credits of approved activities courses to satisfy this requirement
- 9 credit hours must be at the 3000 or higher level.

**Transfer Distribution/HASS**

Distribution/HASS courses may be transferred in for credit. It is important that a student check with the Transfer Services, in the Registrar's Office, to inquire what course(s) may be transferred from a specific institution before a class is taken off-campus.

**International study abroad for Distribution Courses**

General Education International transfer credit for study abroad students (students with transfer credit from institutions outside of the US) will be assigned by the International Programs and Services (IPS) without regard to specific distribution list requirements. It is understood that IPS will apply non-Michigan Tech courses to distribution based on their being equivalent or congruent with existing general education distribution courses. Michigan Tech courses taken as study-abroad will be applied to distribution list requirements based upon the distribution list the course is on.

**Science, Technology, Engineering, Mathematics (STEM) Requirement (16 credits)**

All Michigan Tech baccalaureate graduates must take a minimum of 16 credits of science, technology, engineering, mathematics, or computer science. Check with your department or advisor for major specific requirements. Some programs specify all 16 credits; others may not. For example, a computer science course may be a requirement for some departments but not others.

*Note the following restrictions:*

1. At least 12 of those credits must be outside the student's major field.
2. Students must complete 4 credits or more in mathematics. See list (link below).
3. Students must complete one laboratory science course. See list (link below).

For curricula that do not specify mathematics and lab science requirements, students can meet these requirements by taking courses listed at: [STEM Courses \(Math/Lab Science Requirement\)](#).

**Cocurricular Requirement (3 units)**

Three **Cocurricular Activities** units are required for graduation. A unit involves the same time commitment as an academic semester credit but is not included in calculation of the GPA, or in the overall degree-credit requirement. Repeatable courses may not be repeated for co-curricular general education credit.

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

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

*Please note that most physical education activities will last for seven and one-half weeks, or one-half semester. A student would need six of these 0.5-semester units to fulfill the 3-semester-unit co-curricular requirement. Some ROTC courses are also approved for co-curricular activity, and a few of these (and a few PE courses) are a full semester in length and count for 1 semester unit. These are identified in the course descriptions list, which is effective fall 2001. These are identified in the course descriptions list, which is available here: [Cocurricular Courses](#)*

### **General Education Curriculum Links**

[General Education Goals](#)

### **Simplified General Education Transfer Credit Rules**

In 2001, transfer credit for General Education was simplified, particularly in the Distribution List area. This first document lists the rules currently in place for transfer credit and the other document lists earlier changes:

- [General Education Transfer Credit Codes](#) (Fall 2008)
- [General Education Transfer Credit CHANGE](#) (memo, Fall 2007)
- [Transfer credit - General Education](#) (2005)
- [Transfer credit - General Education](#) (memo, 2001)

# Humanities, Arts, and Social Sciences (HASS) Distribution Courses

2011-2012 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:

- 6 credit hours must be at the 3000 or 4000 level.
- 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 HASS Courses

General Education international transfer credit, for students who participate in an international study abroad experience, will be assigned by International Programs and Services (IPS). It is understood that IPS will apply non-MTU courses 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

BL3970	Current Health Issues	3
EC2001	Principles of Economics	3
EC3002	Microeconomic Theory	3
EC3003	Macroeconomic Theory	3
EC3100	International Economics	3
EC3300	Industrial Organization	3
EC3400	Economic Decision Analysis	3
EC3500	Public Economics	3
EC3700	Labor/Human Resource Economics	3
EC4620	Energy Economics	3
EC/GE4630	Mineral Industry Economics	3
EC4640	Natural Resource Economics	3
EC4650	Environmental Economics	3
ED3110	Psychological Foundation of Education	3
EH3010	Sports Psychology	3
ENT4954	Global Competition	1
FA2112	Acoustic and Electronic Music Composition*	3
FA2222	Hearing the Movies*	3
FA2300	Two-Dimensional Design*	3
FA2330	Art Appreciation*	3
FA2500	Music Theory I*	3
FA2520	Music Appreciation*	3
FA2800	Script Analysis*	3
FA3300	Three-Dimensional Design	3
FA3330	Art History I	3
FA3340	Art History II	3
FA3530	Music Theory II	3
FA3550	History of Jazz	3
FA3560	Music History	3
FA3570	The History of Country and Western Music*	3
FA3625	History of Rock*	3
FA3735	Music, Film and Theatre Sound	3
FA3810	Ancient Theatre History	3
FA3821	Modern Theatre History	3
FA3830	American Musical Theatre	3
FW3110	Natural Resource Policy	3
FW/SS3760	Human Dimensions of Natural Resources	3
GE2800	Water and Society	3
HU2110	The Writer's Craft*	3
HU2130	Introduction to Rhetoric*	3
HU2241	Level I-A Less Commonly Taught Languages*	3
HU2242	Level I-B Less Commonly Taught Languages*	3
HU2271	Level I-A French Language & Culture*	3
HU2272	Level I-B French Language & Culture	3
HU2273	Transitional Level I French Language & Culture*	3
HU2281	Level I-A German Language & Culture*	3
HU2282	Level I-B German Language & Culture	3
HU2291	Level I-A Spanish Language & Culture*	3
HU2292	Level I-B Spanish Language & Culture	3
HU2293	Transitional Level I Spanish Language & Culture*	3

HU2324	Introduction to Film*	3
HU2400	Introduction to Diversity Studies*	3
HU2501	American Experience in Literature*	3
HU2505	Science, Technology & Humanities*	3
HU2520	Cultural Diversity in American Literature*	3
HU2540	The Spoken Word*	3
HU2538	British Experience in Literature*	3
HU2548	Young Adult Literature*	3
HU2700	Introduction to Philosophy*	3
HU2701	Logic and Critical Thinking*	3
HU2702	Ethical Theory and Moral Problems*	3
HU2820	Communication and Culture*	3
HU2910	Language and Mind*	3
HU2920	Language and Society*	3
HU3110	The Writer's Workshop	3
HU3130	Rhetorical Theory and Criticism	3
HU3150	Reading and Writing	3
HU3151	The Rhetoric of Everyday Texts	3
HU3241	Level II A Commonly Taught Language & Culture	3
HU3242	Level II B Less Commonly Taught Language & Culture	3
HU3253	World Literatures & Cultures	3
HU3261	Communicating Across Cultures	3
HU3262	Topics in Francophone Cultures	3
HU3263	Topics in German-Speaking Culture	3
HU3264	Topics in Spanish-Speaking Culture	3
HU3271	Level II-A French Language & Culture	3
HU3272	Level II-B French Language & Culture	3
HU3273	Level II French Composition & Conversation	3
HU3274	Topics in French Literature & Culture	3
HU3275	French for Special Purposes	3
HU3281	Level II-A German Language & Culture	3
HU3282	Level II-B German Language & Culture	3
HU3283	Level II German Composition & Conversation	3
HU3284	Topics in German Literature & Culture	3
HU3285	German for Special Purposes	3
HU3291	Level II-A Spanish Language & Culture	3
HU3292	Level II-B Spanish Language & Culture	3
HU3293	Level II Spanish for Special Purposes	3
HU3294	Topics in Spanish Literature & Culture	3
HU3295	Advanced Spanish for Special Purposes	3
HU3400	Topics in Diversity Studies*	3
HU3501	Medieval Literature & Cultures	3
HU3502	World Mythologies	3
HU3504	Studies in the Novel	3
HU3510	The American Novel	3
HU3513	Shakespeare	3
HU3517	Literary Theory and Criticism*	3
HU3540	Major British Authors	3
HU3541	Major American Authors	3
HU3545	Literature Across Borders*	3
HU3554	Science Fiction and Fantasy Literature	3
HU3555	Modern and Contemporary British Literature	3
HU3621	Introduction to Journalism	3
HU3629	Special Topics in Professional Writing	3
HU3700	Philosophy of Science	3
HU3701	Philosophy of Technology	3
HU3702	Philosophy of Religion	3
HU3710	Engineering Ethics	3
HU3711	Biomedical Ethics	3
HU3820	Interpersonal Communication	3
HU3840	Organizational Communication	3
HU3850	Cultural Studies	3
HU3860	Popular Culture	3
HU3871	Media and Communication Theory	3
HU3882	Media Industries	3
HU3890	Documentary	3
HU3910	Global Language Issues	3
HU3940	Language and Identity	3



HU4271	Modern Language Seminar I-French	3	SS3820	Ethical, Legal, & Societal Implications of Nanotechnology	3
HU4272	Modern Language Seminar II-French	3	SS3910	Histories and Cultures	3
HU4273	Modern Language Seminar III-French	3	SS3920	Topics in Anthropology/Archaeology	3
HU4281	Modern Language Seminar I-German	3	SS3950	Topics in American History	3
HU4282	Modern Language Seminar II-German	3	SS3990	Topics in the Social Sciences	var
HU4283	Modern Language Seminar III-German	3	SS4200	Environmental Anthropology	3
HU4291	Modern Language Seminar I-Spanish	3	UN3404	Cultural Immersion	2
HU4292	Modern Language Seminar II-Spanish	3	<b>HASS Creative Endeavors List</b>		
HU4293	Modern Language Seminar III-Spanish	3	No more than 3 credits from the HASS Creative Endeavors list may be used to satisfy the HASS Distribution List requirements.		
HU4625	Risk Communication	3	FA2050	Drawing I*	3
HU4700	Topics in Philosophy	3	FA2150	Creative Drawing*	3
HU4701	Political Philosophy	3	FA2200	Watermedia I*	3
HU4890	Topics in Communication	3	FA2305	Ceramics I*	3
IS3001	International Studies In situ	var	FA2430	R & D Jazz Band*	1
MA4945	History of Mathematics	3	FA2580	Group Voice*	2
MGT4800	Ecology and Organizations	3	FA2600	Acting I*	3
PSY2000	Principles of Psychology*	3	FA2610	Acting II: Scene Study	3
PSY2300	Developmental Psychology	3	FA3150	Life Drawing	3
PSY2400	Health Psychology	3	FA3200	Creative Watermedia	3
PSY2600	Psychology of Death and Dying	3	FA3305	Creative Ceramics	3
PSY3010	Theories of Personality	3	FA3333	Sculpture*	3
PSY3030	Abnormal Psychology	3	FA3335	Sculpture II	3
PSY3070	Cross-Cultural Psychology	3	FA3360	Ceramic Sculpture	3
PSY/SS3720	Social Psychology	3	FA3400	Keweenaw Symphony Orchestra*	1
PSY3750	Judgment and Decision Making	3	FA3401	Wind Symphony*	1
PSY3800	Environmental Psychology	3	FA3430	Jazz Lab Band*	1
PSY3850	Human Factors Psychology	3	FA3510	Concert Choir*	1
PSY4010	Cognitive Psychology	3	HU2631	Fundamentals of Photography*	3
SS2100	World Peoples and Environments*	3	HU2632	Fundamentals of Digital Photography*	3
SS2200	Prehistory and Archaeology*	3	SS3210	Field Archaeology	var
SS2400	Introduction to Human Geography	3	<b>HASS Supplemental List</b>		
SS2500	The American Experience*	3	No more than 3 credits from the HASS Supplemental list may be used to satisfy the HASS Distribution List requirements.		
SS2550	Themes in Western Civilization*	3	AF2001	History US Air/Space Power I	1
SS2600	American Government & Politics*	3	AF2002	History US Air/Space Power II	1
SS2610	Introduction to Law and Society	3	AF3001	Leadership Studies I	3
SS2700	Introduction to Sociology*	3	AF4001	National Security Affairs I	3
SS3110	Food Systems	3	AR4001	Developing Adaptive Leaders	var
SS3200	Historical Archaeology	3	BA3580	Legal Environment of Business	3
SS3230	Archaeology of Industry	3	CM3410	Technical Communication for Chem. Engineering	3
SS3250	Human Origins and Evolution	3	ED3510	Communicating Science I	2
SS3260	Latin American Cultural History	3	ED3511	Communicating Science II	1
SS3300	Environmental Problems	3	ENT2961	Teaming in the Enterprise	2
SS3313	Sustainable Science Policy & Assessment	3	ENT2962	Communication Contexts	1
SS3400	Contemporary Europe	3	ENT3958	Ethics in Engineering Design and Implementation	1
SS3410	World Resources & Development	3	ENT3961	Enterprise Strategic Leadership	1
SS3500	Modern American History	3	ENT3962	Communication Strategies	1
SS3505	Military History of the U.S.	3	ENT4952	Complex Communication Practices	1
SS3510	History of American Technology	3	FA2080	Presentation Skills*	3
SS3511	History of Science in America	3	FA2830	Voice and Articulation*	3
SS3512	Building America: The History of Planning, Engineering And Development in the United States	3	GE2100	Environmental Geology*	3
SS3515	History of American Architecture	3	HU2830	Introduction to Speech Communication*	3
SS3520	U.S. Environmental History	3	HU3120	Technical and Scientific Communication	3
SS3521	Energy in America	3	MGT3100	Leadership Development*	3
SS3530	The Automobile in America*	3	MGT/SS3650	Intellectual Property Management	3
SS3540	History of Michigan	3	PSY3500	Human Robot Interaction	3
SS3541	The Copper Country*	3	PSY3700	Industrial Organizational Psychology	3
SS3550	Europe to 1650	3	PSY3850	Human Factors Psychology	3
SS3551	Europe in the Modern Era	3	SS3640	Selected Topics in Cyber-Law	3
SS3552	Renaissance and Reformation	3	UN3401	Environmental Stewardship	2
SS3560	History of England I	3	UN3405	Language Immersion	2
SS3561	History of England II	3			
SS3570	History of Canada	3			
SS3580	Technology & Western Civilization	3			
SS3600	American Foreign Policy	3			
SS3610	International Law	3			
SS3630	Environmental Policy & Politics	3			
SS3660	Constitutional Law	3			
SS3661	Civil Rights & Civil Liberties	3			
SS3700	Industry and Society	3			
SS3710	Social Problems	3			
SS3750	Social Inequality	3			
SS3800	Energy Technology and Policy	3			
SS3801	Science, Technology, & Society	3			
SS3810	Anthropology of Science and Technology	3			

# Science, Technology, Engineering and Mathematics (STEM) Courses

## 2011-2012 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, including both the lab and the corresponding lecture.
- Students must complete a minimum of 4 credit hours in mathematics at the 1000-level or higher
- At least 12 STEM 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:

BL1010	General Biology I	4
BL1020	General Biology II	4
BL1040	Principles of Biology	4
BL2011	Anatomy & Physiology Lab I (plus BL2010)	4
BL2160	Botany	4
BL2170	Zoology	4
BL3310	Environmental Microbiology	3
BL3400	Principles of Ecology	4
BL4130	Phycology	3
BL4440	Fish Biology	4
BL4740	Introduction to Mycology	3
BL4810	Plant Taxonomy	3
CH1151	University Chemistry Lab I (plus CH1150)	4
CH1112	University Chemistry – Studio Lab I	5
CH1122	University Chemistry – Studio Lab II	5
CH1161	University Chemistry Lab II (plus CH1160)	4
EH3700	Lifetime Fitness	3
FW1035	Wood Anatomy and Properties	4
FW2010	Vegetation of North America	4
FW3020	Forest and Landscape Ecology	3
FW3330	Soil Science	4
FW3610	Ornithology	4
FW3621	Field Ornithology Techniques	3
FW4220	Wetlands	4
FW4240	Mammalogy	4
GE2000	Understanding the Earth	3
GE2300	Earth Materials I: Mineralogy	3
GE2500	Introduction to Oceanography	3
GE3320	Earth History and Paleoclimatology	3
GE3710	Geology and Ecology of Reefs	2
GE3720	Soil Genesis and Crops	2
GE3850	Geohydrology	3
GE4100	Geomorphology and Glacial Geology	4
GE4150	Natural Hazards	3
PH1091	The Physics Behind Music Lab (plus PH1090)	4
PH1100	Physics by Inquiry I (plus PH2100)	4
PH1111	College Physics I Laboratory (plus PH1110)	4
PH1141	Applied College Physics I Laboratory (plus PH1140)	4
PH1161	Introduction to Experimental Physics I (plus PH1160)	5
PH1200	Physics by Inquiry II (plus PH2200 or PH1210 or PH1240)	4
PH1610	Introductory Astronomy Laboratory (plus PH1600)	3
SS3220	Archaeological Sciences	4

### · Mathematics (4 credits)

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

- BUS2300, Quantitative Problem Solving (previously BA2110)
- EC4200, Econometrics
- EH1500, Foundations of Kinesiology
- EH2200, Human Reproductive Health and Development
- MIS2100, Intro to Business Programming (previously BA2200)
- PSY2720, Statistics for Social and Behavioral Sciences
- PSY3060, Physiological Psychology
- SS3220, Archaeological Sciences

*Any course 1000 level or higher in the following disciplines:*

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

*Except for the following courses which may not be used to satisfy STEM requirements because they are included on the HASS list:*

BL3970, CM3410, ENT2961, ENT2962, ENT3958, ENT3961, ENT3962, ENT4952, ENT4954, FW3110, FW3760, GE2100, GE2800, GE4630, MA4945

*\*Except for the following ENT courses which may not be used to satisfy STEM requirements:*

ENT1960, ENT3954, ENT3963, ENT3964, ENT3971, ENT4951

## Co-curricular Courses 2011-2012 Academic Year

Three co-curricular units are required for graduation. A unit involves the same time commitment as an academic semester credit but is not included in calculation of the GPA, nor in the overall degree-credit requirement. Repeatable courses may not be repeated for co-curricular general education credit.

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

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

### Co-curricular Courses

AF0120	Physical Conditioning	.5	PE0174	Winter Outdoor Adventures	.5
AF0130	Air Force Elite Forces Workout	1	PE0175	Hiking	.5
AF0230	Precision Drill Team	.5	PE0200	Fitness Foundations	1
AF0340	Field Training	1	PE0201	Fitness Foundations II	1
AR2068	Fall Military Physical Conditioning	1	PE0205	Intermediate Bowling	.5
AR2069	Spring Military Physical Conditioning	1	PE0206	Intermediate Golf	.5
AR3068	Physical Training Leadership I	1	PE0210*	Special Topics in Physical Education	.5
AR3069	Physical Training Leadership II	1	PE0215	Intermediate Swimming	.5
FA2400	Huskies Pep Band	1	PE0216	Intermediate Basketball	.5
FA2402	Campus Concert Band	1	PE0217	Intermediate Hockey	.5
PE0101	Flag Football	.5	PE0218	Intermediate Weight Training	.5
PE0103	Bait and Fly Casting	.5	PE0220	Intermediate Alpine Ski (Downhill)	.5
PE0104	Ultimate Frisbee	.5	PE0221	Intermediate Snowboarding	.5
PE0105	Beginning Bowling	.5	PE0222	Alpine Ski Racing	.5
PE0106	Beginning Golf	.5	PE0223	Freestyle Alpine Skiing	.5
PE0107	Floor Hockey	.5	PE0224	Snowboard Racing (Bordercross)	.5
PE0108	Broomball	.5	PE0225	Freestyle Snowboarding	.5
PE0109	Aikido	.5	PE0226	Intermediate Volleyball	.5
PE0113	Disc Golf	.5	PE0227	Intermediate Archery	.5
PE0114	Frisbockey	.5	PE0230	Water Polo	.5
PE0115	Beginning Swimming	.5	PE0232	Intermediate Soccer	.5
PE0116	Beginning Basketball	.5	PE0235	Intermediate Cross Country Ski	.5
PE0117	Beginning Hockey	.5	PE0237	Intermediate Table Tennis	.5
PE0118	Beginning Weight Training	.5	PE0238	Intermediate Racquetball/Squash	.5
PE0120	Beginning Alpine Skiing (Downhill)	.5	PE0239	Intermediate Badminton	.5
PE0121	Beginning Snowboarding	.5	PE0240	Intermediate Tennis	.5
PE0122	Softball	.5	PE0246	Intermediate Billiards	.5
PE0123	Telemark Skiing	.5	PE0248	Intermediate Skating	.5
PE0125	Sand Volleyball	.5	PE0252	Intermediate Social Dance	.5
PE0126	Beginning Volleyball	.5	PE0253	Intermediate Aerobics	.5
PE0127	Beginning Archery	.5	PE0256	Intermediate Mountain Biking	.5
PE0130	Water Aerobics	.5	PE0266	Running for Fitness	.5
PE0132	Beginning Soccer	.5	PE0267	Intermediate Yoga	.5
PE0135	Beginning Cross Country Skiing	.5	PE0268	Intermediate Pilates	.5
PE0137	Table Tennis	.5	PE0270	Intermediate TaeKwonDo and Hapkido	.5
PE0138	Beginning Racquetball/Squash	.5	PE0306	Advanced Golf	.5
PE0139	Beginning Badminton	.5	PE0315	Fitness Swimming	.5
PE0140	Beginning Tennis	.5	PE0320	Advanced Skiing	.5
PE0145	Beginning Rifle	.5	PE0321	Advanced Snowboarding	.5
PE0146	Beginning Billiards	.5	PE0340	Advanced Tennis	.5
PE0148	Beginning Skating	.5	PE0355	Advanced Road Biking	.5
PE0150	Outdoor Lifetime Activities	.5	PE0406	Indoor Golf	.5
PE0151	Indoor Lifetime Activities	.5	PE0420	Ski Instructor Training	.5
PE0152	Beginning Social Dance	.5	PE0421	Snowboard Instructor Training	.5
PE0153	Beginning Aerobics	.5	PE1470	Lifeguard Swimming	1
PE0155	Beginning Road Biking	.5	PE1580	Water Safety Skills	1
PE0156	Beginning Mountain Biking	.5	PE2010	Varsity Football	1
PE0165	Rowing	.5	PE2020	Varsity Basketball	1
PE0166	Moving for Fitness	.5	PE2028	Ski Patrol (Hill)	1
PE0167	Beginning Yoga	.5	PE2030	Varsity Hockey	1
PE0168	Beginning Pilates	.5	PE2040	Varsity Nordic Skiing	1
PE0169	Spinning	.5	PE2050	Varsity Soccer	1
PE0170	Beginning TaeKwonDo and Hapkido	.5	PE2080	Varsity Track	1
PE0173	Fall Outdoor Adventures	.5	PE2090	Varsity Tennis	1
			PE2130	Varsity Volleyball	1
			PE2140	Varsity Cross Country	1
			PE2150	Cross Training	1
			PE2230	Cheerleading Dance Team	1
			PE2240	Cheer Team	1

\*PE0210 may only be repeated once for general education co-curricular credit if topics are different.

# Undergraduate Course Descriptions

## Effective Fall 2011

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### Accounting

#### ACC 2000 - Accounting Principles I

Introduction to basic principles, concepts, and theoretical framework of financial accounting with the emphasis on its use by economically rational decision makers. Topics include the decision-making environment and the accounting cycles, processes, and statements.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring, Summer

#### ACC 2100 - Accounting Principles II

Emphasizes the role of accounting information within a firm. Topics include budgeting, responsibility accounting, cost allocations, cost behavior, decision models, capital budgeting, and an introduction to product costing in manufacturing and service sector firms.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring, Summer

**Pre-Requisite(s):** ACC 2000 or BA 2300 or BA 2330

#### ACC 3000 - 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

**Pre-Requisite(s):** ACC 2100 or BA 2310 or BA 2340

#### ACC 3100 - Accounting Theory/Practice II

A continuation of ACC 3000 with theories, concepts, and practices underlying financial measurement and reporting. Focuses on the measurement and reporting of liabilities and equities, and includes multinational issues.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** (ACC 3000 and FIN 3000(C)) or (BA 3300 and BA 3400)

#### ACC 3500 - Managerial/Cost Accounting I

The primary emphasis is on traditional and contemporary product costing techniques, cost allocation practices, and basic cost-management issues. Topics include process costing, standard costing, activity-based costing, backflush costing, cost allocation issues, balanced scorecard, strategic profitability analysis, and the role of accounting in contemporary management practices.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** ACC 2100 or BA 2310 or BA 2340

#### ACC 3600 - Foundations of Taxation

Introduction to basic principles, concepts, and theoretical framework of taxation systems, emphasizing income taxation and its impact on decision making. Topics include tax planning and compliance for individuals, corporations, and partnerships.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** ACC 2100 or BA 2310 or BA 2340

#### ACC 4100 - 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:** Fall

**Pre-Requisite(s):** ACC 3100 or BA 3310

#### ACC 4200 - Advanced Accounting

The theory and practice of financial accounting and reporting pertaining to business combinations and consolidated financial statements, accounting for partnerships, and related business forms, foreign currency transactions, and financial statement translations, and other advanced accounting topics.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** ACC 3100 or BA 3310

#### ACC 4500 - Managerial/Cost Accounting II

Emphasizes information requirements of contemporary management decision-making and strategic-planning processes. Covers contemporary control and evaluation practices (such as activity-based management), determining the costs of quality, and productivity analysis in the context of accounting information systems.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** ACC 3500 or BA 3320

#### ACC 4600 - Advanced Tax Topics

Continuation of ACC3600. Introduction to advanced principles and concepts of taxation, emphasizing income taxation and its impact on decision making. Topics include tax planning and compliance for estates and trusts, gratuitous transfers, multi-jurisdictional operations, and entity formations, liquidations, and reorganizations.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** ACC 3600 or BA 4310

#### ACC 4700 - Governmental and Not-for-Profit Accounting

An in-depth study of the accounting principles and financial reporting unique to the governmental and not-for-profit sectors of the U.S. economy.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** ACC 3100 or BA 3310

#### ACC 4800 - Accounting Systems

Introduction to the basic principles, concepts, and theoretical framework for the design and operation of accounting information systems, emphasizing its use to enhance decision making. Topics include system design, internal controls, the use of databases, and electronic commerce.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** ACC 2100 or BA 2310 or BA 2340

#### ACC 4900 - Special Topics in Accounting

Examines current issues in Accounting 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):** ACC 3310 or BA 3310

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### Air Force ROTC

#### AF 0120 - Physical Conditioning

Activities that promote physical conditioning. Emphasis is on individual conditioning through strength and aerobic training and team sports such as ultimate frisbee and football. May be used once as a general education co-curricular course. Sports physical required prior to start of class (contact instructor for details).

**Credits:** 0.5; Graded Pass/Fail Only

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

**Semesters Offered:** Spring

#### AF 0130 - Air Force Elite Forces Workout

An intense workout program that develops personal physical fitness and self-confidence. Workouts include an elite U.S. Military special operations training. Basic swimming skills required.

**Credits:** 1.0; Graded Pass/Fail Only

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

**Semesters Offered:** 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. May be used once as a general education co-curricular course. Non-cadets are required to provide a uniform cleaning deposit and purchase some non-returnable uniform items.

**Credits:** 0.5; Graded Pass/Fail Only

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

**Semesters Offered:** Fall

**Restrictions:** Permission of instructor required

**AF 0340 - Field Training**

A rigorous program of physical conditioning, team activities, and survival training. Offered the summer semester after acceptance into the Field Training program. Course completed off campus.

**Credits:** 1.0; Graded Pass/Fail Only

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

**Semesters Offered:** Summer

**Restrictions:** Permission of instructor required

**AF 1001 - Foundations of US Air Force I**

Introduces students to the USAF and ROTC. Topics include Air Force mission and organization, officership, professionalism, military customs and courtesies, officer opportunities, and communication skills. Leadership Laboratory is mandatory for AFROTC cadets and complements this course by providing cadets with followership experiences.

**Credits:** 1.0

**Lec-Rec-Lab:** (0-1-2)

**Semesters Offered:** Fall

**AF 1002 - Foundations of US Air Force II**

Introduces students to the USAF and ROTC. Topics include Air Force mission, organizations, officership, professionalism, military customs, courtesies, officer opportunities, and communication skills. Leadership Laboratory is mandatory for AFROTC cadets and complements this course by providing cadets with followership experiences.

**Credits:** 1.0

**Lec-Rec-Lab:** (0-1-2)

**Semesters Offered:** Spring

**AF 2001 - 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:** Fall

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

**AF 3002 - Leadership Studies II**

Study of leadership in civilian and military institutions. Topics include officership, 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:** Fall

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

**AF 4002 - National Security Affairs II**

This course examines selected roles of the military in society, unconventional warfare, current issues affecting the military profession, and the military justice system. Special topics of interest focus on information warfare, the law of armed conflict, the military as a profession, and officership.

**Credits:** 3.0

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

**Semesters Offered:** Spring

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

**Army ROTC****AR 1001 - Foundations in Officership**

Introduction to the challenges and competencies that are critical for effective leadership. Students learn how the personal development of "life skills" such as goal setting, stress management, physical fitness and time management relate to leadership, officership, 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:** Spring

**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:** (0-0-3)

**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:** (0-0-3)

**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:** (0-1-0)

**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:** (0-1-0)

**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, individual and squad level tactics, techniques and procedures.

**Credits:** 1.0

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

**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:** (0-0-3)

**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 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 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

**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

**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

**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  
**Pre-Requisite(s):** CH 1150 and ENG 1102 and MA 2160 and PH 2100 and UN 1001



**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):** CH 1150 and ENG 1102 and MA 2160 and PH 2100 and UN 1001

**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

**Pre-Requisite(s):** (BE 2400 or BL 2400) and MY 2100 and (MEEM 2150(C) or ENG 2120(C)) and BE 2600

**BE 3600 - 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(C) and BL 2021 and BE 2600

**BE 3750 - Human Biomechanics**

Introduction to the analysis of anatomical structures, movements, and mechanics of the musculoskeletal system, including properties and strength of materials. Includes application of Newtonian mechanics, statics, and strength of materials of bone, muscle, tendon, and other biologic materials. Credit may not be received for both BE3750 and MEEM4180.

**Credits:** 3.0

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

**Semesters Offered:** Spring

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

**Pre-Requisite(s):** BL 2010 and (MEEM 2150 or ENG 2120) and BE 2600

**BE 4000 - Independent Study**

Students undertake an independent study under the guidance of a Biomedical Engineering faculty member. The course of study may either be research or academic and is decided upon between the student and faculty member.

**Credits:** variable to 6.0; Repeatable to a Max of 12

**Semesters Offered:** Fall, Spring, Summer

**Restrictions:** Permission of instructor and department required

**BE 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 3750 or MEEM 4150 and (BE 2400 or BL 1040)

**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 or BL 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 or BL 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 and (BE 2400 or BL 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:** Spring - Offered alternate years beginning with the 2009-2010 academic year

**Pre-Requisite(s):** BE 3500

**BE 4610 - Biological Microscopy for Engineers**

The goal of the course is to inform students of the different imaging techniques available and to help them determine which imaging technique(s) would be most useful for a particular biomedical engineering application.

**Credits:** 3.0

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

**Semesters Offered:** Fall - Offered alternate years beginning with the 2011-2012 academic year

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

**BE 4660 - 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 instrumentations.

**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 3600

**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 - Biomaterials Interfaces**

This course introduces the students to the effects of topography and texture on the performance of biomaterials. Special emphasis is placed on tissue engineering scaffolds and microfabrication and nanofabrication techniques. Some of the topics also include self-organization of biomembranes and supramolecular systems, bioactive materials, and the molecular basis for surface recognition and masking.

**Credits:** 3.0

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

**Semesters Offered:** Spring - Offered alternate years beginning with the 2010-2011 academic year

**Pre-Requisite(s):** BE 3500

**BE 4880 - 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

**Pre-Requisite(s):** BE 2600

**BE 4900 - Biomedical Design Fundamentals**

Design considerations and professional practice issues are addressed. Ethics, regulatory affairs, and intellectual property are addressed within the context of the biomedical engineering profession. Modern tools of biomedical design are presented and applied to current problems.

**Credits:** 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

**BE 4901 - Biomedical Design Project I**

Team approach is used to resolve a defined problem in biomedical engineering. Projects are selected and undertaken with faculty guidance and sponsor input. Must be senior project ready, as defined by major, substitutes for prerequisites.

**Credits:** 2.0

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

**Semesters Offered:** Fall

**Restrictions:** Must be enrolled in one of the following Major(s): Biomedical Engineering; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

**Co-Requisite(s):** BE 4900

**Pre-Requisite(s):** BE 3500(C) and BE 3600 and (BE 3750 or MEEM 4180)

**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):** (BE 2400 or BL 2400) and BL 2020

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**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**

Basic principles through which biological systems operate. Topics include cell biology, structure, and function, energy production, genetics, physiology, diversity, evolution, and ecology.

**Credits:** 4.0

**Lec-Rec-Lab:** (3-0-2)

**Semesters Offered:** Fall, Summer

**Restrictions:** May not be enrolled in one of the following Major(s): Clinical Laboratory Science, Biological Sciences

**BL 1580 - Introduction to Biological Sciences**

Introduction to fields and career opportunities in the biological sciences.

**Credits:** 1.0

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

**Semesters Offered:** Fall

**BL 1590 - Introduction to the Health Professions**

Introduction to various careers in the health professions. Discusses required course work, entrance exams, and other requirements for entry to the various fields. Guest lecturers include representatives of many health areas.

**Credits:** 1.0

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

**Semesters Offered:** Fall

**BL 1600 - Introduction to Clinical Laboratory Science**

Introduction to subdisciplines, the clinical practicum, career opportunities, and current issues in clinical laboratory science.

**Credits:** 1.0

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

**Semesters Offered:** Fall

**BL 1710 - Medical Terminology**

Autotutorial course covers the fundamentals of medical terminology, including recognition and use of common prefixes, roots, and suffixes, as well as single-syllable words. Exercises also include spelling and pronunciation.

**Credits:** 1.0

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

**Semesters Offered:** Fall

**BL 1800 - Biochemistry Orientation**

Introduction to current research and career opportunities in biochemistry with emphasis on the interdisciplinary nature of the field.

**Credits:** 1.0

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

**Semesters Offered:** Fall

**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, Summer

**Pre-Requisite(s):** CH 1112 or (CH 1150 and CH 1151)

**BL 2011 - Anatomy & Physiology I Lab**

The laboratory to accompany BL2010. Examines embryology, muscle and skeletal anatomy, and neuroanatomy. Explores the physiology of the nervous system, including vision and reflexes and muscle physiology. A student-designed lab project is used to teach experimental design.

**Credits:** 1.0

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

**Semesters Offered:** Fall, Summer

**Pre-Requisite(s):** BL 2010(C)

**BL 2020 - Anatomy & Physiology II**

Continuation of BL2010. Covers the cardiovascular, respiratory, digestive, renal, and reproductive systems.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** BL 2010

**BL 2021 - Anatomy & Physiology II Lab**

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

**Credits:** 1.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** BL 2011 and BL 2020(C)

**BL 2100 - Principles of Biochemistry**

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

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** BL 1020 or BL 1040 or BE 2400 or BL 2400 and CH 1112 or (CH 1150 and CH 1151)

**BL 2160 - Botany**

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

**Credits:** 4.0

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

**Semesters Offered:** Spring

**BL 2170 - Zoology**

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

**Credits:** 4.0

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

**Semesters Offered:** Fall

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

**BL 2200 - Genetics**

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

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** (BL 1020 or BL 1040 or BE 2400) and (BL 2100 or CH 4710)

**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

**Pre-Requisite(s):** CH 1150 and ENG 1102 and MA 2160 and PH 2100 and UN 1001

**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

**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

**Pre-Requisite(s):** BL 1020 or BL 1040

**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

**BL 3070 - Biology & Occupational Hygiene**

The first third of this course will cover fundamentals of cellular and organismal biology. The remainder of the course covers the toxic effects of occupational chemicals, energy forms and industrial pollutants on human tissue.

Emphasizes recognition, evaluation, and control of health hazards in the workplace.

**Credits:** 3.0

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

**Semesters Offered:** Fall

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

**Pre-Requisite(s):** CH 1170 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):** BL 1020 or BL 1040

**BL 3210 - General Microbiology**

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

**Credits:** 4.0

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

**Semesters Offered:** Fall

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

**Pre-Requisite(s):** (BL 1020 or BL 1040) and (BL 2100 or CH 4710)

**BL 3220 - Medical Mycology and Virology**

Study of clinically important fungi and viruses.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**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 3210

**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

**BL 3300 - Introduction to Genomics**

Introduction to Genomics. Genome organization, mapping and characterization from humans and related organisms. Topics include hierarchical arrangement of genes, genome mapping, molecular markers of physical genome maps, genome sequencing, comparative genomics, analysis of important human genes and their products, and ethical and legal aspects of genomics.

**Credits:** 3.0

**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:** Fall

**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 1020 or BL 1040 or BL 2020 or BE 2400

**BL 3780 - Medical Parasitology Laboratory**

Stresses the visual identification of common human parasites.

**Credits:** 1.0

**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 4001 - Honors Research in Biology**

A laboratory-based research problem that culminates in a written report and a seminar presentation on the work performed. Open only to biological sciences and clinical laboratory sciences majors accepted into the Honors in Biological Sciences program.

**Credits:** variable to 9.0; Repeatable to a Max of 9

**Semesters Offered:** Fall, Spring, Summer

**Restrictions:** Permission of instructor required; Must be enrolled in one of the following Major(s): Biological Sciences, Clinical Laboratory Science, Bioinformatics

**BL 4002 - Human Genetics**

Biochemical genetics and associated human Mendelian disorders with emphasis on processes of pathophysiology and treatment.

**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 2100 and BL 2200

**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 2410 or CH 2420)

**BL 4020 - Biochemistry II**

Dynamic aspects of living systems. Broad exposure to cellular metabolic pathways, intermediary metabolism and its regulation and bioenergetics.

**Credits:** 3.0

**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 4035 - Bioimaging**

Current concepts in light and electron microscopy and scanning probe techniques. Theory and practice of fluorescence (including confocal and multi-photon), atomic force, scanning and transmission electron, and video microscopy as applied to biological specimens with emphasis on sample preparation. Half semester course.

**Credits:** 2.0

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

**Semesters Offered:** Fall - Offered alternate years beginning with the 2010-2011 academic year

**Restrictions:** Must be enrolled in one of the following Class(es): Junior, Senior

**BL 4042 - Scanning Electron Microscopy of Biological Specimens**

Hands-on training in operation of the scanning electron microscope (SEM). Students prepare biological specimens of their choice for observation. Successful completion of course is prerequisite to becoming a certified SEM operator in the ACMAL. Half semester course.

**Credits:** 2.0

**Lec-Rec-Lab:** (0-2-6)

**Semesters Offered:** Fall - Offered alternate years beginning with the 2010-2011 academic year

**Restrictions:** Must be enrolled in one of the following Class(es): Junior, Senior

**Co-Requisite(s):** BL 4035

**BL 4052 - Fluorescence and Video Microscopy of Biological Specimens**

Hands-on training in fluorescence microscopy and video microscopy. Students prepare biological specimens of their choice for observation. Half semester course.

**Credits:** 2.0

**Lec-Rec-Lab:** (0-2-6)

**Semesters Offered:** Spring - Offered alternate years beginning with the 2010-2011 academic year

**Restrictions:** Must be enrolled in one of the following Class(es): Junior, Senior

**Pre-Requisite(s):** BL 4035

**BL 4062 - Transmission Electron Microscopy of Biological Specimens**

Hands-on training in operation of the transmission electron microscope (TEM). Students prepare biological specimens of their choice for observation. Successful completion of course is prerequisite to becoming a certified TEM operator in ACMAL. Half semester course.

**Credits:** 2.0

**Lec-Rec-Lab:** (0-2-6)

**Semesters Offered:** Spring - Offered alternate years beginning with the 2010-2011 academic year

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

**Pre-Requisite(s):** BL 4035

**BL 4090 - Tropical Island Biology**

A survey of island biology, including marine and terrestrial habitats. Topics include formation of carbonate islands, geological history of the Bahamas, island plant communities, intertidal, grass bed, mangrove and coral reef communities. Special course fees. Consult department before enrolling. Completion of BL1020 or BL1040 desirable but not necessary.

**Credits:** 2.0

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

**Semesters Offered:** Spring

**BL 4100 - Special Topics in Biological Sciences**

A study of recent developments in the biological sciences.

**Credits:** variable to 10.0; Repeatable to a Max of 10

**Semesters Offered:** Fall, Spring, Summer

**BL 4120 - Environmental Remediation and Toxicology**

Toxicology of major environmental pollutants, their dose-response relationships and fundamentals of environmental remediation. Topics include physical, chemical, and biological remediation methods and effect of environmental toxins on biological systems. Laboratory will involve the application of chemical and biological remediation techniques.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring - Offered alternate years beginning with the 2011-2012 academic year

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

**Pre-Requisite(s):** BL 1020 or BL 1040

**BL 4140 - Plant Physiology**

Physiology and biochemistry of plants. Emphasizes photosynthesis, plant hormones, water and nutrient relations, and light-regulated development.

**Credits:** 3.0

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

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

**Pre-Requisite(s):** BL 2160 and CH 2420

**BL 4145 - Plant-Microbe Interactions**

Interactions between plants and microorganisms in the environment. Topics include microbial virulence, signaling, gene expression, beneficial interactions and disease resistance in plants. Laboratory will focus on plant biochemical and microbiological methods as they relate to environmental problems.

**Credits:** 3.0

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

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

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

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

**BL 4220 - 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 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 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**

The study of biological, physical, and chemical processes of freshwater systems using a watershed perspective. Movement of nutrients/organisms from land, via streams/rivers, into lakes will be studied, with emphasis on field work in local lakes/streams.

**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 1122 or (CH 1160 and CH 1161)

**BL 4455 - Research Methods in Aquatic Ecology**

This field and laboratory based course is designed for advanced undergraduate students. Guided by ecological, physiological, and evolutionary theory, we will explore and quantitatively sample flora and fauna, ecosystem processes, and habitat in streams and lakes using traditional and current techniques.

**Credits:** 2.0

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

**Semesters Offered:** Fall - Offered alternate years beginning with the 2011-2012 academic year

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

**Pre-Requisite(s):** BL 3400 or BL 4450 or FW 4220 or ENVE 4505

**BL 4461 - Ecosystem Ecology**

Study of processes in aquatic and terrestrial ecosystems, including energy flow, ecosystem production, and nutrient cycling. We will explore these processes through a historical overview of influential research programs and regional to global case studies.

**Credits:** 3.0

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

**Semesters Offered:** Spring - Offered alternate years beginning with the 2011-2012 academic year

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

**Pre-Requisite(s):** BL 3400 and CH 1122 or (CH 1160 and CH 1161)

**BL 4465 - Biological Oceanography**

An overview of ocean environments and marine life. Topics include: trophic level interactions, nutrient cycling, ecology of plankton, invertebrates, fish, mammal and bird resources, and human influences on marine ecosystems. Will cover basic water chemistry and light in oceans.

**Credits:** 3.0

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

**Semesters Offered:** Spring

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

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

**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, Spring

**Restrictions:** Must be enrolled in one of the following Major(s): Biochem & Molec Biology-Bio Sc, Biological Sciences; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

**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, Biological Sciences; May not be enrolled in one of the following Class(es): Freshman, Sophomore

**Pre-Requisite(s):** BL 2020 and BL 3640

**BL 4610 - 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

**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.

**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 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

**Pre-Requisite(s):** BL 4630

**BL 4640 - Clinical Immunology & Serology**

Integrates basic and clinical immunological principles as well as outlines the diagnosis and evaluation of immune disorders and selected infectious diseases.

**Credits:** 2.0

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

**Semesters Offered:** Fall

**Restrictions:** Must be enrolled in one of the following Major(s): Clinical Laboratory Science, Biological Sciences; May not be enrolled in one of the following Class(es): Freshman, Sophomore

**Pre-Requisite(s):** BL 2410 and BL 3640

**BL 4660 - Current Topics in Clinical Laboratory Science**

Recent developments in Clinical Laboratory Science.

**Credits:** variable to 4.0; Repeatable to a Max of 6

**Semesters Offered:** Fall, Spring

**Restrictions:** Permission of instructor required

**BL 4720 - Hematology and Hemostasis**

Theory and laboratory applications. Emphasis will be placed on hematopoiesis, 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 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 4750 - Clinical Laboratory Instrumentation**

An overview of the principles, applications, and selection of instruments used in clinical laboratory. Lab work includes operation, maintenance, and trouble shooting to obtain experience working with power supplies, centrifuges, spectrophotometers, pH meters, osmometers, radiation counters, and chemistry analyzers, blood cell counters, and other instruments commonly used in a diagnostic laboratory.

**Credits:** 2.0

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

**Semesters Offered:** Spring

**BL 4810 - 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:** Summer

**BL 4820 - Biochemical Laboratory Techniques I**

Laboratory techniques basic to biochemistry and molecular biology with emphasis on protein isolation, characterization and kinetics.

**Credits:** 2.0

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

**Semesters Offered:** Spring, Summer

**Pre-Requisite(s):** BL 4010(C) or CH 4710(C)

**BL 4840 - Molecular Biology Techniques**

Laboratory techniques in molecular biology, including methods of recombinant DNA technology for identification, cloning, and characterization of genes.

**Credits:** 3.0

**Lec-Rec-Lab:** (1-0-4)

**Semesters Offered:** Fall

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

**Pre-Requisite(s):** (BL 2100 or CH 4710) and BL 2200 and BL 4030(C)

**BL 4980 - Clinical Laboratory Science Core Concept Integration and Application**

CLS Program Capstone Course. Review, and subsequently learn to integrate and apply, clinical core course material. Assignments include collaborative exercises involving development, peer review, and presentation of worksheets, case studies, and instrument evaluations, as well as other interactive learning activities.

**Credits:** 2.0

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

**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, Sophomore

**Pre-Requisite(s):** BL 3230(C) and BL 4550(C) and BL 4640 and BL 4720 and BL 4730



**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

**Business****BUS 1100 - Introduction to Business**

Introduction to planning, organizing, decision-making, leadership and control in a business. Business disciplines of accounting, finance, information systems, management, marketing, and operations are introduced, along with discussions of business ethics and social responsibility.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring, Summer

**BUS 2100 - Business Statistics**

Introduction to basic concepts and methods of probability and statistics, including the following topics: collection, description and presentation of data, probability, random variables, sampling, probability distributions, estimation and hypothesis testing, ANOVA, and selected non-parametric techniques.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring, Summer

**Pre-Requisite(s):** MA 1135 or MA 1160 or MA 1161

**BUS 2200 - Business Law**

Provides an understanding of the legal basis of contracts and their enforcement in the areas of general contracts, contracts of commercial sales and of agency, and commercial paper.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring, Summer

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

**BUS 2300 - Quantitative Problem Solving**

Stresses development of quantitative decision and analysis skills to solve problems with cases, exercises, simulations, and mathematical modeling. Topics include regression analysis, decision analysis, stochastic environments, data sources and errors, utility theory risk preference, linear programming, and simulation analysis.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring, Summer

**Pre-Requisite(s):** BA 2100 or BUS 2100(C) or MA 2710(C) or MA 2720(C) or MA 3710(C) or MA 3720(C)

**BUS 3900 - Business Internship**

A practical approach to business problem solving. Requires a report on work activity upon completion of the internship.

**Credits:** variable to 4.0; Repeatable to a Max of 4

**Semesters Offered:** Fall, Spring, Summer

**Restrictions:** Permission of instructor required; Must be enrolled in one of the following College(s): School of Business & Economics

**BUS 4900 - Research 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

**BUS 4990 - Special Topics in Business**

Business topics of interest to students and faculty.

**Credits:** variable to 4.0; Repeatable to a Max of 6

**Semesters Offered:** On Demand

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

**BUS 4991 - Business Development I**

Focuses on the development of a business plan including marketing plans, organization, distribution, and financial projections. Emphasis is on the senior design project or enterprise project assigned to the student.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** (BA 1100 or BUS 1100) and (BA 2110 or BUS 2300) and (BA 2300 or BA 2330 or ACC 2000) and (BA 2310 or BA 2340 or ACC 2100) and (BA 2500 or BUS 2200) and (BA 2700 or MGT 2000) and (BA 3200 or MIS 2000) and (BA 3400 or FIN 3000) and (BA 3610 or OSM 3000) and (BA 3700 or MGT 3000) and (BA 3800 or MKT 3000)

**BUS 4992 - Business Development II**

Completion and presentation of the business plan for the senior design project or enterprise project assigned to the student.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** BA 4991

**Civil Engineering****CE 1000 - Civil Engineering**

An introduction to the civil engineering profession with emphasis on careers open to the civil engineering students. Topics include: scope, specialties, education, professional practice, 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 3101 - Civil Engineering Materials**

Covers properties and behavior of typical civil engineering materials, including wood, metals, aggregates, asphalt cement concrete, portland cement concrete, and composites. Laboratory exercises demonstrate selected engineering mechanics principles, including elastic, inelastic, and time-dependent material behavior. Additional topics include testing techniques, materials standards, report writing, and presentation of experimental data.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-2-3)

**Semesters Offered:** Fall, Spring

**Pre-Requisite(s):** ENG 2120 or MEEM 2150

**CE 3202 - Structural Analysis**

Introduction to structural concepts and techniques for analyzing trusses, determinate and indeterminate beams, and frame structures. Apply concepts from statics and mechanics of materials to determine internal forces and deflections of structural members and systems, including loads and load paths.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring

**Pre-Requisite(s):** ENG 2120 or MEEM 2150

**CE 3331 - Professional Practice**

Professional expectations of civil and environmental engineers demonstrated through readings, discussion, and writing. Topics include the consequences of engineering, design issues, legal aspects, ethical considerations, government requirements, management, leadership, and contract issues.

**Credits:** 2.0

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

**Semesters Offered:** Fall, Spring

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

**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:** (0-3-0)

**Semesters Offered:** Fall, Spring, Summer

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

**CE 3620 - 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 ENVE 3502(C) or CE 3710(C))

**CE 3650 - Hydraulics and Hydrology**

Course is intended for graduate students who need additional coursework in this subject matter. Topics covered include pipe flow, distribution networks, culverts, rivers and channels, hydrologic cycle, flooding, precipitation, infiltration, evaporation, and runoff. Same material as CE3620, but without the lab.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring

**Restrictions:** Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

**CE 3710 - Uncertainty Analysis in Engineering**

Introduction to probability, statistics, and uncertainty analysis with examples from civil engineering (e.g. models of vehicle arrivals, structural reliability, flood distributions). Topics include: discrete probability theory, probability distributions, parameter estimation, confidence intervals, hypothesis tests, linear regression, and model selection.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** MA 2160

**CE 3730 - Systems Dynamics and Design**

Introduces principles of systems engineering as applicable to studying the behavior of engineering systems such as transportation, utility, service, construction, and project management systems. Students are introduced to Queueing Theory, Markov Chains, and System Dynamics.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Restrictions:** May not be enrolled in one of the following Class(es): Freshman  
**Pre-Requisite(s):** (BUS 2100(C) or BA 2100 or MA 3710(C) or MA 2720(C) or CE 2710(C)) and (MA 1135 or MA 1160 or MA 1161)

**CE 3810 - Soil Mechanics for Engineers**

Develops the terminology and descriptions common to the field. Studies soil compressibility, fluid flow, response to mechanical compaction, and strength as well as methods of determining geostatic stresses and stress changes due to boundary loadings. An experimental laboratory experience reinforces the lecture material.

**Credits:** 4.0

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

**Semesters Offered:** Fall, Spring, Summer

**Pre-Requisite(s):** (GE 2000 or GE 2100) 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:** Spring

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

**CE 4020 - Computer Applications: Visualizing and Communicating Design Information**

Problem-solving using industry standard software, such as Civil3D, is applied to civil and environmental engineering projects such as terrain modeling, earth work calculations, and pavement alignment. Concepts involving data management, data visualization, and risk analysis are introduced.

**Credits:** 3.0

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

**Semesters Offered:** Fall

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

**Pre-Requisite(s):** ENG 1003 and CE 3332 or CE 3401(C)

**CE 4050 - Green Building Design**

An overview of practice for designing and constructing sustainable building following Leadership in Energy and Environmental Design (LEED) guidelines. Intensive two week class will include hands on practice with LEED, energy modeling, and an exploration of sustainable construction.

**Credits:** 3.0

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

**Semesters Offered:** Summer

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

**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 2201 or CE 3202

**CE 4213 - Structural Concrete Design**

Introduction to design of reinforced concrete structural components. Analyze and design reinforced concrete beams, columns, and footings. Understand material behavior, limit state criteria, and practical detailing considerations. Application of the ACI 318 to cast-in-place and precast systems.

**Credits:** 4.0

**Lec-Rec-Lab:** (0-3-2)

**Semesters Offered:** Spring

**Pre-Requisite(s):** CE 2201 or CE 3202

**CE 4223 - Steel Design I**

Behavior and design of structural steel members using both ASD and LRFD approaches. Covers material behavior, external loads, and the design of tension, compression, and flexural members (rolled, built-up, and composite), and simple welded and bolted connections.

**Credits:** 4.0

**Lec-Rec-Lab:** (0-3-2)

**Semesters Offered:** Fall

**Pre-Requisite(s):** CE 2201 or CE 3202

**CE 4233 - Structural Timber Design**

Introduction to the use of wood as a structural engineering material. Includes design of beams, columns, nailed and bolted connection, glulam members, including tapered beams, tapered and curved beam, and design of wood shear walls and diaphragms.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** CE 2201 or CE 3202

**CE 4333 - Estimating and Planning of Construction Projects**

Examination of the principles and techniques of estimating construction costs leading to the development of an estimate and proposal submission. The relationship between the contract specification, drawings, and the estimate will be illustrated.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** CE 3332

**CE 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**

Analysis, behavior, performance, and structural design of highway pavements. Introduces pavement types and performance concepts, highway traffic and subgrade characterization, materials employed in highway construction, and highway drainage. Presents common methods used for designing pavement structures as well as mechanistic- empirical approaches.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** CE 3401

**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, ROADSOFIT, 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 - Railroad Engineering**

Overview of basic elements and roles of rail transportation, history, organizations and economics, safety, intercity and urban passenger rail, freight operations, track-train dynamics, signals and communications, motive power and equipment, track components, construction and maintenance.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**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 4490 - Rail Transportation Seminar**

Presentations and discussion of current literature and research related to rail transportation.

**Credits:** 1.0

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

**Semesters Offered:** Spring

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

**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, Summer

**Pre-Requisite(s):** CE 3620

**CE 4750 - Risk Analysis and Management**

Fundamentals methods in analyzing and mitigating risks involved in services that function at the interface of human, natural and engineered systems. Relevant systems include transportation, service, utility, emergency and hazard management, and project management.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Restrictions:** Must be enrolled in one of the following Class(es): Senior

**Pre-Requisite(s):** OSM 3730 or CE 3730 or SSE 3730 or SSE 2300

**CE 4760 - Optimization Methods in Decision Making**

Decision analysis and optimization techniques, including linear programming, nonlinear programming, and dynamic programming. Computer-based solutions of design problems in various engineering specialty areas are considered.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Restrictions:** Must be enrolled in one of the following Class(es): Senior

**Pre-Requisite(s):** MA 2160 and (MA 2320 or MA 2321 or MA 2330)

**CE 4820 - Foundation Engineering**

Applies the fundamentals learned in CE3810 to problems in geotechnical engineering. Learn the procedures used to design footings, piled foundations, retaining walls, marine structures, and slopes. Computational laboratory reinforces lectures; students have direct access to the instructor as the design is being developed.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** CE 3810

**CE 4830 - Geosynthetics Engineering**

Geosynthetic materials are grouped by mechanical characteristics and engineering use. They are widely used in highway, landfill, and embankment design. Develop designs for filters, soil separators, reinforced earth, and impermeable membranes. Also learn when using a geotextile is appropriate.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** CE 3810

**CE 4850 - Rock Engineering for Civil Engineers**

This course focuses on the applied behavior of rock encountered primarily in civil engineering projects. Topics include rock classification, rock durability, rock mass strength classification, use of stereo nets, rock reinforcement, blasting, rock socket application and bearing capacity on rock.

**Credits:** 3.0

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

**Semesters Offered:** Spring - Offered alternate years beginning with the 2009-2010 academic year

**Pre-Requisite(s):** CE 3810

**CE 4900 - Engineering Design Project I**

An engineering design project related to civil and environmental engineering. Not available to students who have taken CE4905. Students must complete both CE4900 and CE4910 to fulfill senior design requirements. Must be senior project ready as defined by major department.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-2-3)

**Semesters Offered:** Fall, Summer

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

**CE 4905 - Engineering Design Project**

An engineering design project related to civil and environmental engineering. Not available to students who have taken CE4900 or CE4910. (Senior project ready as defined by major substitutes for prerequisites)

**Credits:** 3.0

**Lec-Rec-Lab:** (0-2-3)

**Semesters Offered:** Fall, Spring, Summer

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

**CE 4910 - Engineering Design Project II**

Continuation of CE4900. Not available to students who have taken CE4905. Students must complete both CE4900 and CE4910 to fulfill senior design requirements. Senior project ready as defined by major substitutes for prerequisites.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-2-3)

**Semesters Offered:** Spring, Summer

**Pre-Requisite(s):** CE 4900

**CE 4915 - International Engineering Field Experience**

An engineering design project that incorporates an international experience. Must be taken in conjunction with CE4916 in order to fulfill senior design requirements. Must be senior project ready as defined by major department.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-2-3)

**Semesters Offered:** Fall, Spring, Summer

**Restrictions:** Must be enrolled in one of the following Class(es): Senior

**Pre-Requisite(s):** ENG 3530

**CE 4916 - International Senior Design Field Project**

An engineering design project that incorporates an international experience. Must be taken in conjunction with CE4915 in order to fulfill senior design requirements. Senior project ready as defined by major substitutes for prerequisites.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-2-3)

**Semesters Offered:** Fall, Spring, Summer

**Restrictions:** Must be enrolled in one of the following Class(es): Senior

**Pre-Requisite(s):** CE 4915

**CE 4920 - Civil Engineering Independent Study**

Approved research or design project in civil engineering, originating with an individual student or assigned by the instructor.

**Credits:** variable to 3.0; Repeatable to a Max of 3

**Semesters Offered:** Fall, Spring, Summer

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

**CE 4990 - Special Topics in Civil 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

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**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:** 3.0

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

**Semesters Offered:** Fall, Summer

**CH 1112 - University Chemistry - Studio Laboratory I**

Introduces experimental and theoretical chemical concepts from a hands-on, inquiry-based perspective. Emphasis is placed on experimental methods, reactions and stoichiometry, states of matter, thermochemistry, periodicity and bonding, solutions, and kinetics.

**Credits:** 5.0

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

**Semesters Offered:** Fall

**Restrictions:** Must be enrolled in one of the following Major(s): Biochem & Molec Biology-Chem, Pharmaceutical Chemistry, Chemistry, Cheminformatics

**Pre-Requisite(s):** MA 1031 or MA 1032

**CH 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 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): Biochem & Molec Biology-Chem, Pharmaceutical Chemistry, Chemistry, Cheminformatics

**CH 1150 - University Chemistry I**

Introduces the foundations of chemistry, including electronic structure of atoms and molecules, intermolecular forces, states of matter, chemical reactions, organic chemistry, chemical equilibria, kinetics, and acid-base chemistry. Includes laboratory component that emphasizes lecture components.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring, Summer

**Co-Requisite(s):** CH 1151

**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:** (0-1-0)

**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 1112 or (CH 1150 and CH 1151)

**CH 1161 - University Chemistry Laboratory II**

Laboratory to accompany CH1160.

**Credits:** 1.0

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

**Semesters Offered:** Fall, Spring, Summer

**Co-Requisite(s):** CH 1160

**Pre-Requisite(s):** 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 1150 and CH 1151

**CH 1170 - University Chemistry II-IOB General, Organic, and Bio**

This course includes essential topics of general, organic, and biochemistry. Selected topics are solution chemistry, acid-base reactions, oxidation-reduction reactions, organic compound structures, nomenclature, and reactions, carbohydrates, protein structure, and enzyme activity.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Restrictions:** May not be enrolled in one of the following Major(s): Biochem & Molec Biology-Chem, Pharmaceutical Chemistry, Chemistry, Cheminformatics

**Pre-Requisite(s):** CH 1112 or (CH 1150 and CH 1151)

**CH 2212 - Quantitative Analysis**

Measurements and calculations relevant to volumetric and gravimetric analysis as well as electrochemistry and separations. Error analysis and statistical treatment of data. In the laboratory, introduces classical and contemporary techniques that require high quality measurements.

**Credits:** 5.0

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

**Semesters Offered:** Spring

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

**CH 2410 - Organic Chemistry I**

A study of the chemistry of carbon compounds. Review of hybrid orbitals, covalent bonding, and resonance. Introduction to nomenclature, stereochemistry, infrared and nuclear magnetic resonance spectroscopy, functional group chemistry based on reaction mechanisms, and multi-step synthesis.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Summer

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

**CH 2411 - Organic Chemistry Lab I**

Laboratory to accompany CH2410.

**Credits:** 1.0

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

**Semesters Offered:** Fall, Summer

**Pre-Requisite(s):** CH 2410(C) and CH 1122 or (CH 1160 and CH 1161)

**CH 2420 - Organic Chemistry II**

Continuation of CH2410. Covers more functional group chemistry based on reaction mechanisms; more involved multi-step synthesis; introduction to carbohydrates, amino acids, proteins, nucleic acids; and topics of specialized interest.

**Credits:** 3.0

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

**Semesters Offered:** Spring, Summer

**Pre-Requisite(s):** CH 2410

**CH 2421 - Organic Chemistry Lab II**

Laboratory to accompany CH2420.

**Credits:** 2.0

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

**Semesters Offered:** Spring, Summer

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

**CH 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.

**Credits:** 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 Class(es): Freshman, Sophomore

**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.

**Credits:** 2.0

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

**Semesters Offered:** Fall

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

**Pre-Requisite(s):** CH 1122 or CH 1170 or (CH 1160 and CH 1161) and MA 2160

**CH 3501 - 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. Course offered first half of spring semester.

**Credits:** 2.0

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

**Semesters Offered:** Spring

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

**Pre-Requisite(s):** CH 1122 or CH 1170 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.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring, Summer

**Pre-Requisite(s):** CH 1122 or (CH 1160 and CH 1161) and MA 2160 and PH 2200(C)

**CH 3511 - Physical Chemistry Lab I**

Laboratory to supplement CH3510.

**Credits:** 2.0

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

**Semesters Offered:** Fall, Spring, Summer

**Pre-Requisite(s):** CH 3510(C)

**CH 3520 - Physical Chemistry II - Molecular Structure**

Continuation of CH3510. Covers solid-state chemistry, surface chemistry, atomic and molecular spectroscopy and structure, chemical applications of group theory, valence, the periodic table, elements of quantum mechanics, and statistical thermodynamics.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** CH 1122 or (CH 1160 and CH 1161) and MA 3160 and PH 2200(C)

**CH 3521 - Physical Chemistry Lab II**

Laboratory to supplement CH3520.

**Credits:** 2.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** CH 3520(C)

**CH 3540 - Biophysical Chemistry**

Examines fundamental physical principles underlying complex biological systems in order to understand the interactions and behaviors found in biological, biochemical, and physical systems. Topics include macromolecules in aqueous environments, spectroscopy and structure determination, kinetics, membranes, and transport phenomena.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** (BL 1020 or BL 1040) and CH 1122 or (CH 1160 and CH 1161) and MA 2160 and PH 2200

**CH 3541 - Biophysical Chemistry Laboratory**

Examines the physical methods employed in the study of biological systems, including structure determination, spectroscopy, microscopy, imaging, and modeling. The core objective is application of the fundamentals developed in the Biophysical Chemistry course to systems of biological relevance.

**Credits:** 2.0

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

**Semesters Offered:** Spring

**Co-Requisite(s):** CH 3540

**CH 4110 - Pharmaceutical Chemistry: Drug Action**

Focuses on structural and mechanistic approaches to pharmaceuticals and drug action. General principles of absorption, distribution, action, metabolism and toxicity of drugs will be presented followed by action of drug classes such as antibiotics, cardiovascular, and anti-inflammatory drugs.

**Credits:** 3.0

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

**Semesters Offered:** Spring

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

**Pre-Requisite(s):** BL 4010 or CH 4710

**CH 4120 - Pharmaceutical Chemistry: Drug Design**

Focuses on the important concepts in the design and synthesis of drugs.

Rational basis for drug design including synthetic, computational and biochemical concepts will be discussed. Topics include structure-activity relationships, synthesis and reaction mechanism, and case studies of drugs.

**Credits:** 3.0

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

**Semesters Offered:** Fall

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

**Pre-Requisite(s):** CH 2420

**CH 4190 - Current Topics in Pharmaceutical Chemistry**

Discussion of recent topics in pharmaceutical chemistry.

**Credits:** variable to 3.0; Repeatable to a Max of 12

**Semesters Offered:** On Demand

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

**CH 4210 - Instrumental Analysis**

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

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** CH 2212 and CH 3510(C) and CH 3511(C)

**CH 4212 - Instrumental Analysis**

Chemical instrumentation applied to organic and inorganic analysis with emphasis on chromatography and spectroscopy.

**Credits:** 5.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** CH 2212 and CH 3510(C) and CH 3511(C)

**CH 4222 - Bioanalytical Chemistry**

An overview of modern analytical and instrumental techniques with emphasis on approaches relevant to measurements in biochemistry. Theory and methods of chromatographic separation methods, biomolecule quantification and electrophoretic characterization. Error analysis and statistical treatment of data also covered.

**Credits:** 5.0

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

**Semesters Offered:** Fall, Spring

**Restrictions:** May not be enrolled in one of the following Major(s):

Cheminformatics, Chemistry; May not be enrolled in one of the following Class(es): Freshman

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

**CH 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.

**Credits:** 1.0

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

**Semesters Offered:** Fall

**Restrictions:** Permission of department required

**Pre-Requisite(s):** 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.

**Credits:** 1.0

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

**Semesters Offered:** Fall

**Restrictions:** Permission of department required

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

**CH 4290 - Current Topics in Analytical Chemistry**

Discussion of recent topics in analytical chemistry.

**Credits:** variable to 3.0; Repeatable to a Max of 12

**Semesters Offered:** On Demand

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

**CH 4292 - Independent Study in Analytical Chemistry**

An undergraduate research experience in analytical chemistry. Students select a literature and/or laboratory problem and write a summary report.

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

**Semesters Offered:** On Demand

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

**CH 4310 - Inorganic Chemistry I**

Descriptive chemistry of the main group elements with some emphasis on the structure and theory of bonding with transition metal complexes. Examines bonding, physical and chemical properties, structure, and reactions of the chemical elements and their compounds.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** CH 3520

**CH 4311 - Inorganic Chemistry Laboratory**

Laboratory preparations (selected inorganic and organometallic compounds) that illustrate appropriate experimental techniques for synthesis of molecules; measurement of chemical properties, structures, and phenomena; hands-on experience with modern instrumentation; computational data analysis (by means of single crystal X-ray Diffraction experiments).

**Credits:** 2.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** CH 4310(C)

**CH 4320 - Inorganic Chemistry II**

Continuation of CH4310. Descriptive chemistry of the transition group elements. Transition metal compounds; aspects of bonding, spectra, and reactivity; complexes of p-acceptor ligands; organometallic compounds and their role in catalysis; metals in biological systems; preparative, analytical, and instrumental techniques.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**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 spectramodelling, data handling and presentation, and spectral database packages.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** CH 2420

**CH 4430 - Intermediate Organic Chemistry**

Develop the chemical intuition necessary for advanced work in organic chemistry. Emphasizes reaction mechanisms and why reactions occur. Topics include heteroaromatic 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

**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 4515 - Atmospheric Chemistry**

Study of the photochemical processes governing the composition of the troposphere and stratosphere, with application to air pollution and climate change. Covers radical chain reaction cycles, heterogeneous chemistry, atmospheric radiative transfer, and measurement techniques for atmospheric gases.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Restrictions:** May not be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Class(es): Senior

**Pre-Requisite(s):** (CH 3510 and CH 3520(C)) or (ENVE 4501 and ENVE 4504)

**CH 4519 - Transport and Transformation of Organic Pollutants**

Assessment of factors controlling environmental fate, distribution, and transformation of organic pollutants. Thermodynamics, equilibrium, and kinetic relationships are used to quantify organic pollutant, partitioning, and transformations in air, water, and sediments. Use of mass balance equations to quantify pollutant transport.

**Credits:** 3.0

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

**Semesters Offered:** Fall - Offered alternate years beginning with the 2009-2010 academic year

**Restrictions:** Must be enrolled in one of the following Class(es): Senior

**Pre-Requisite(s):** ENVE 4501(C) or CH 3510

**CH 4560 - Computational Chemistry**

Focuses on the theory and method of modern computational techniques applied to the study of molecular properties and reactivity through lecture and computer projects. Covers classical mechanical as well as quantum mechanical approaches.

**Credits:** 3.0

**Lec-Rec-Lab:** (2-0-3)

**Semesters Offered:** Fall - Offered alternate years beginning with the 2010-2011 academic year

**Pre-Requisite(s):** CH 3520

**CH 4590 - Current Topics in Physical Chemistry**

Discussion of recent topics in physical chemistry.

**Credits:** variable to 3.0; Repeatable to a Max of 12

**Semesters Offered:** On Demand

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

**CH 4610 - Introduction to Polymer Science**

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

**Credits:** 3.0

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

**Semesters Offered:** Fall

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

**CH 4620 - Polymer Chemistry**

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

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring

**Pre-Requisite(s):** CH 2420



**CH 4631 - Polymer Science Laboratory**

Students undertake experiments covering aspects of polymer characterization, processing, and recycling. Also included are experiments in applications such as coatings, adhesives, and composites.

**Credits:** 2.0

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

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

**Pre-Requisite(s):** CH 4610(C) or CM 4610(C)

**CH 4690 - Current Topics in Polymer Chemistry**

Discussion of current topics in polymer chemistry.

**Credits:** variable to 3.0; Repeatable to a Max of 12

**Semesters Offered:** On Demand

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

**CH 4710 - Biomolecular Chemistry I**

Examines chemical concepts underlying biomolecules and bioprocesses and interconnections between biology and chemistry. Bioorganic mechanisms and biophysical concepts in biochemistry are emphasized. Topics include biomolecules including proteins and nucleic acids and bioprocesses including catalysis and gene action.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**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. Topics include metabolic pathways, membrane biophysics, ion-channels, cell communication, transcriptional control and molecular biology.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Restrictions:** May not be enrolled in one of the following Class(es): 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:** (0-0-7)

**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 2411 and CH 3020

**CH 4910 - Chemistry Seminar**

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 instructor required

**CH 4995 - Undergrad Research in Biochem**

Undergraduate research experience in Biochemistry where students work on independent research projects under the direction of biochemistry faculty performing research in areas of biophysics, biochemistry, and molecular biology. Instructor permission required.

**Credits:** variable to 6.0; Repeatable to a Max of 12

**Semesters Offered:** Fall, Spring, Summer

**Restrictions:** Permission of instructor required

**Chemical Engineering****CM 2110 - Fund of Chem Engg 1**

Application of chemical engineering fundamentals to the design and analysis of chemical processes. Mass balances, energy balances, and fundamentals concepts are applied. Introduces use of Process Flowsheet Simulation Software.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Summer

**Pre-Requisite(s):** CH 1112 or (CH 1150 and CH 1151)

**CM 2120 - Fund of Chem Engg 2**

Application of mass and energy balances to common chemical engineering operations. Mass balances, energy balances, and fundamental concepts are applied to flow in piping systems, pumps, compressors and stagewise separations (distillation, absorption/desorption, and extraction). Advanced use of Process Flowsheet Simulations software.

**Credits:** 3.0

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

**Semesters Offered:** Spring, Summer

**Pre-Requisite(s):** CM 2110

**CM 2200 - Intro Minerals and Materials**

Fundamentals of minerals processing, raw materials production, and extractive metallurgy, including primary metals production.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**CM 3110 - Transport/Unit Operations 1**

Develop an understanding of the processes of momentum transfer (fluid mechanics) and heat transfer. Presents the basic equations of microscopic momentum and heat transfer, along with macroscopic transport equations that can be used in engineering analysis.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring

**Pre-Requisite(s):** CM 2120 and (MA 3520 or MA 3521 or MA 3530 or MA 3560) and MA 3160 and PH 2100

**CM 3120 - Transport/Unit Operations 2**

Mass transfer fundamentals applied to unit operations. Topics include Fick's Law, continuity equation with reaction and mass transfer co-efficients. Transient heat transfer and numerical solution are covered. Applications include absorption, distillation, extraction, adsorption, and membrane separations.

**Credits:** 3.0

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

**Semesters Offered:** Spring

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

**Pre-Requisite(s):** CM 3110 and CM 2120 and (MA 3520 or MA 3521 or MA 3530 or MA 3560)

**CM 3215 - 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 3230 - Thermodynamics for Chemical Engineers**

First and second law applied to closed and open systems. Topics include energy conversion, power cycles, entropy and enthalpy calculations on engineering systems; property estimation for non-ideal vapors, liquids, and other substances, non-ideal multicomponent equilibria, chemical reaction equilibria.

**Credits:** 4.0

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

**Semesters Offered:** Fall, Spring, Summer

**Pre-Requisite(s):** CH 3510 and MA 3160 and (MA 3520(C) or MA 3521(C) or MA 3530(C) or MA 3560(C))

**CM 3310 - Process Control**

Covers methods of analyzing the transient behavior of chemical processing systems. Develops methods of analyzing systems and system components along with the special mathematical techniques needed. These concepts are then applied to illustrate mathematical modeling of large-scale chemical processing systems.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** (MA 3520 or MA 3521 or MA 3530 or MA 3560) and PH 2200 and CM 2110 and CM 2120

**CM 3410 - 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 2110 and CM 3110 and CM 3230(C) and (MA 3520 or MA 3521 or MA 3530 or MA 3560) and CH 2410

**CM 3820 - Sampling Statistics and Instrumentation**

Solids sampling theory, practice, and instrumentation for process streams. Statistics/probability as they apply to representative samples from bulklots. Minimization of errors, proper design of sample collection apparatus, statistical design and analysis, and measurements of temperature, flow rate will be covered.

**Credits:** 3.0

**Lec-Rec-Lab:** (2-0-3)

**Semesters Offered:** Spring - Offered alternate years beginning with the 2006-2007 academic year

**CM 3974 - Fuel Cell Fundamentals**

This course provides an introduction to fuel cells and fuel cell systems. Topics include an overview of fuel-cell construction, fuel-cell chemistry, fuel-cell losses and efficiency, and integrating fuel cells into vehicles.

**Credits:** 1.0

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

**Semesters Offered:** Fall, Spring

**Pre-Requisite(s):** CH 1112 or (CH 1150 and CH 1151)

**CM 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 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 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, flocculation, 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 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 1122 or (CH 1160 and CH 1161)

**CM 4620 - Polymer Chemistry**

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

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring

**Pre-Requisite(s):** CH 2420

**CM 4631 - Polymer Science Laboratory**

Students undertake experiments covering aspects of polymer characterization, processing, and recycling. Also included are experiments in applications such as coatings, adhesives, and composites.

**Credits:** 2.0

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

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

**Pre-Requisite(s):** CM 4610(C)

**CM 4650 - Polymer Rheology**

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

**Credits:** 3.0

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

**Semesters Offered:** Spring

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

**CM 4655 - Polymer Rheology Laboratory**

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

**Credits:** 1.0

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

**Semesters Offered:** Fall

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

**Pre-Requisite(s):** CM 4610(C) or CH 4610(C) or CM 4650(C)

**CM 4710 - Biochemical Processes**

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

**Credits:** 3.0

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

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

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

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

**CM 4740 - Hydrometallurgy/Pyrometallurgy**

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

**Credits:** 4.0

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

**Semesters Offered:** Spring

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

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

**CM 4770 - Analytical Microdevice Technologies**

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

**Credits:** 3.0

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

**Semesters Offered:** Spring - Offered alternate years beginning with the 2011-2012 academic year

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

**Pre-Requisite(s):** PH 2200

**CM 4855 - CM Process Analysis & Design I**

Capstone technical and economic evaluations of processes and unit operations. Application of cost estimation, energy efficiency, and economic evaluation techniques. Teams analyze an existing facility, identify improvement opportunities, demonstrate the economic consequences, and recommend a course of action.

**Credits:** 3.0

**Lec-Rec-Lab:** (2-0-3)

**Semesters Offered:** Fall

**Pre-Requisite(s):** CM 3120 and CM 3230 and CM 3410 and CM 3510 and CH 2410

**CM 4860 - CM Process Analysis & Design 2**

Process and project design principles applied to realistic problems, including project evaluation and management. Problems include safety, environmental, and operability constraints. Emphasizes the profit motive in industry and the role of the chemical engineer.

**Credits:** 2.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** CM 4855

**CM 4861 - CM Design Laboratory 2**

Individual/team projects to optimize designs for new ventures with realistic constraints. Requires process synthesis, market research, economic evaluation, and risk analysis techniques. Develops skills in problem solving, critical thinking, and communication. May include the AIChE National Student Design problem.

**Credits:** 1.0

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

**Semesters Offered:** Spring

**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:** variable to 3.0

**Semesters Offered:** Fall

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

**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

**Construction Management****CMG 1000 - Introduction to Construction Management**

Introduction to the construction management profession, and current issues and trends in residential and commercial construction industries. Focuses on how the construction industry works, along with enhancing verbal, CAD, and print reading 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:** Fall

**Pre-Requisite(s):** 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:** Spring

**Pre-Requisite(s):** CMG 1140

**CMG 2265 - Construction Quantity Survey**

An introduction to the interpretation of construction drawings to perform quantity take-offs. Emphasis is on the civil and architectural components of building construction, with some discussion of other elements.

**Credits:** 3.0

**Lec-Rec-Lab:** (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**

An examination of land development issues including: site analysis, environmental concerns, contouring, earthwork and grading, soils, route alignments, storm water management, sewer systems, zoning, and land planning. Incorporates CAD applications in the lab.

**Credits:** 4.0

**Lec-Rec-Lab:** (0-3-2)

**Semesters Offered:** Spring

**Restrictions:** Must be enrolled in one of the following Class(es): Junior, Senior

**Pre-Requisite(s):** SU 2000

**CMG 3250 - Structural Analysis and Design**

Elastic theory analysis and design of steel structural components, including tension, compression, truss frames, flexural beams, and connections. Includes an introduction to reinforced concrete structures and timber. All work is according to current applicable code manuals. Design projects include computer applications.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Restrictions:** Must be enrolled in one of the following Class(es): Junior, Senior

**Pre-Requisite(s):** CMG 2120 or 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

**Pre-Requisite(s):** CMG 3200(C)

**CMG 4100 - Construction Equipment Management**

Study of basic principles used in the construction industry for selecting and managing construction equipment. Focuses on understanding the time value of money, estimating equipment ownership and operating costs, selecting the proper equipment for specific tasks, and estimating equipment production.

**Credits:** 3.0

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

**Semesters Offered:** On Demand

**Restrictions:** Must be enrolled in one of the following Class(es): Junior, Senior

**Pre-Requisite(s):** CMG 3265 and EC 3400

**CMG 4120 - Construction Planning and Scheduling**

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:** Spring

**Restrictions:** Must be enrolled in one of the following Class(es): Junior, Senior

**Pre-Requisite(s):** BA 2500 or BUS 2200

**CMG 4210 - Construction Project Management**

Provides students with an understanding of the principles required to deliver a construction project on time, within budget, and with acceptable quality. Topics include construction law, contracts, delivery systems, 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

**Pre-Requisite(s):** CMG 4200

**CMG 4300 - Construction Finance and Accounting**

Focuses on the principles of accounting and financial management needed to make construction projects and companies financially successful. Includes profitability, projecting costs, cash flow and cash requirements, and equipment costs.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Restrictions:** Must be enrolled in one of the following Class(es): Junior, Senior

**Pre-Requisite(s):** (BA 2300 or ACC 2000) and EC 3400

**CMG 4400 - Construction Safety Management**

Provides an awareness and understanding of workplace safety practices. Emphasis on the construction industry, including the OSHA construction regulations.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Restrictions:** Must be enrolled in one of the following Class(es): Junior, Senior

**CMG 4800 - Sustainable Construction**

An introduction to the philosophy and practice of sustainable building construction with emphasis on underlying socio-environmental philosophies, sustainable directed building technologies and materials, and case studies of contemporary green buildings to culminate in a simple sustainable design project.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Restrictions:** Must be enrolled in one of the following Class(es): Junior, Senior

**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(C) and CMG 4210 and HU 3120

**CMG 4996 - Special Topics in Construction Management**

Selected additional topics of interest in Construction Management based on student and faculty demand and interest. May be a tutorial, seminar, workshop, project, or class study.

**Credits:** variable to 3.0; Repeatable to a Max of 6

**Semesters Offered:** On Demand

**Restrictions:** Permission of instructor required; Must be enrolled in one of the following Major(s): Construction Management; Must be enrolled in one of the following Class(es): Senior

**CMG 4997 - Independent Study in Construction Management**

Independent study of an approved topic under the guidance of a Construction Management faculty member. May be either an academic, design or research problem/project.

**Credits:** variable to 3.0; Repeatable to a Max of 6

**Semesters Offered:** On Demand

**Restrictions:** Permission of instructor required; Must be enrolled in one of the following Major(s): Construction Management; Must be enrolled in one of the following Class(es): Senior

**CMG 4998 - Undergraduate Research in Construction Management**

An undergraduate research experience in Construction Management. Under the guidance of a Construction Management faculty member, students work on a selected/approved research 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): Construction Management; Must be enrolled in one of the following Class(es): Senior

**CMG 4999 - Professional Practice Seminar**

Expand student knowledge on topics relevant to the construction profession through participation in NAHB and other applicable venues.

**Credits:** 1.0; Repeatable to a Max of 6

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

**Semesters Offered:** Fall, Spring

**Restrictions:** Must be enrolled in one of the following Class(es): Sophomore, Junior, Senior

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## Computer Science

**CS 1000 - Explorations in Computing**

An introduction to the study of computing: fundamental concepts and skills; opportunities at Michigan Tech; career opportunities; social and ethical issues.

**Credits:** 1.0

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

**Semesters Offered:** Fall

**Restrictions:** Must be enrolled in one of the following Major(s): Software Engineering, Computer Science, Computer Systems Science, Computer Engineering, Electrical Engineering; Must be enrolled in one of the following Class(es): Freshman

**CS 1090 - Special Topics in Computer Science**

Special topics in computer science offered on occasion based on student and faculty demand and interest.

**Credits:** variable to 3.0; May be repeated

**Semesters Offered:** On Demand

**Restrictions:** Permission of instructor required

**CS 1121 - Introduction to Programming I**

Starting point of the computer science programs. A high-level, object-oriented programming language is introduced as a problem-solving tool. Topics include design, coding, documentation, debugging, and testing of programs.

Programming assignments are given in both a closed lab setting and as homework.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring, Summer

**Pre-Requisite(s):** MA 1031(C) or MA 1032(C)

**CS 1122 - Introduction to Programming II**

Continuation of CS 1121. Topics include data abstraction, class hierarchies and polymorphism, list, stack, queue and tree data structures, complexity-based algorithm and data structure choices, and recursion. Homework programming assignments are given.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring, Summer

**Pre-Requisite(s):** CS 1121

**CS 1131 - Accelerated Introduction to Programming**

An alternative starting point of the computer science programs for students with some programming experience, combining material from CS1121 and CS1122, offered at an accelerated pace. Homework programming assignments are given.

**Credits:** 5.0

**Lec-Rec-Lab:** (0-5-0)

**Semesters Offered:** Fall

**Restrictions:** Permission of department required

**Pre-Requisite(s):** MA 1031 or MA 1032

**CS 1141 - C for Java Programmers**

Programming in C for students with prior experience in Java. Topics include program structure, the preprocessor, arrays, structures, pointers, input/output, dynamic memory management, and linked data structures.

**Credits:** 2.0

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

**Semesters Offered:** Fall, Spring

**Pre-Requisite(s):** CS 1122 or CS 1131 or CS 1090

**CS 2090 - Special Topics in Computer Science**

Special topics in computer science offered on occasion based on student and faculty demand and interest.

**Credits:** variable to 3.0; May be repeated

**Semesters Offered:** On Demand

**Restrictions:** Permission of instructor required

**CS 2311 - Discrete Structures**

Presents fundamental concepts in discrete structures that are used in computer science. Topics include sets, trees, graphs, functions, relations, recurrences, proof techniques, logic, combinatorics, and probability.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring, Summer

**Pre-Requisite(s):** (CS 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 abstract data types (priority queues, dictionaries and graphs) and their implementations, algorithm analysis, sorting, text processing, and object oriented design. A significant programming project is assigned.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring

**Pre-Requisite(s):** CS 1122 or CS 1131

**CS 3000 - Ethical and Social Aspects of Computing**

An examination of social and ethical issues associated with computing. Topics include: ethical theories and decision making, intellectual property, freedom of expression, privacy, security, and professional responsibility.

**Credits:** 2.0

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

**Semesters Offered:** Fall, Spring

**Restrictions:** Must be enrolled in one of the following Class(es): Junior, Senior

**Pre-Requisite(s):** CS 3141

**CS 3090 - Special Topics in Computer Science**

Special topics in computer science offered on occasion based on student and faculty demand and interest.

**Credits:** variable to 3.0; May be repeated

**Semesters Offered:** On Demand

**Restrictions:** Permission of instructor required

**CS 3141 - Team Software Project**

This course introduces software design techniques (e.g., Design-By-Contracts), uses the UML for requirements and design specification, and requires implementation, unit testing and documentation in the context of a significant team project. Other topics: teamwork, user interfaces, social and professional responsibility.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring

**Pre-Requisite(s):** CS 2311 and CS 2321

**CS 3311 - Formal Models of Computation**

Introduction to the theory of formal languages and computation. Topics include regular languages and finite automata, context-free languages and push-down automata, Turing-acceptable languages, Turing machines and the halting problem. Proof techniques and applications, such as parsing, are also treated.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring

**Pre-Requisite(s):** CS 2311



**CS 3331 - Concurrent Computing**

Concepts and techniques in concurrent computing. Topics include: processes and threads, mutual exclusion, semaphores, monitors and condition synchronization, deadlock, safety and liveness, message passing, and concurrent architectures.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring

**Pre-Requisite(s):** CS 1141 and CS 2311 and CS 2321

**CS 3411 - Systems Programming**

Development of robust programs that provide efficient services to system software developers. Topics include: file I/O, process creation and management, linking and libraries, interprocess communication, performance measurement, and socket programming.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring

**Pre-Requisite(s):** CS 1141 and CS 3421

**CS 3421 - Computer Organization**

Introduction to the logical structure of computers, including the fundamentals of logic design, information storage and manipulation, control, input/output, and assembly language programming. Topics include a review of current hardware technology, combinational and sequential logic, arithmetic, datapaths, hard-wired 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 1122 or CS 1131

**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)

**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):** (MA 1160 or MA 1161) and (MA 2320(C) or MA 2321(C) or MA 2330(C)) and CS 2321

**CS 4090 - Special Topics in Computer Science**

Special topics in computer science offered on occasion based on student and faculty demand and interest.

**Credits:** variable to 4.0; May be repeated

**Semesters Offered:** On Demand

**Restrictions:** Permission of instructor required

**CS 4099 - Directed Study in Computer Science**

Students study one or more special topics in computer science under the direction of one or more faculty members.

**Credits:** variable to 4.0; Repeatable to a Max of 6

**Semesters Offered:** Fall, Spring, Summer

**Restrictions:** Permission of instructor required

**CS 4121 - Programming Languages**

A discussion of the concepts underlying programming languages. Topics include programming paradigms; language properties (including syntax, semantics, run-time behavior, and implementation issues); data, procedure, functional, and control abstraction; functional programming; and logic programming.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring

**Pre-Requisite(s):** CS 1141 and CS 2321 and CS 3421 and CS 3311

**CS 4130 - Compiler Design and Optimization**

Design, theory, and implementation of programming language translators. Topics include: intermediate representations, advanced code generation, control and data-flow analysis, advanced compiler optimization, dynamic compilation, global register allocation and instruction scheduling. A major project is required.

**Credits:** 4.0

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

**Semesters Offered:** Spring

**Restrictions:** May not be enrolled in one of the following Level(s): Graduate

**Pre-Requisite(s):** CS 4121

**CS 4321 - Introduction to Algorithms**

Fundamental topics in algorithm design, analysis, and implementation. Analysis fundamentals include asymptotic notation, analysis of control structures, solving recurrences, and amortized analysis. Design and implementation topics include sorting, searching, and graph algorithms. Design paradigms include greedy algorithms, divide-and-conquer algorithms, and dynamic programming.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring

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

**Pre-Requisite(s):** CS 2311 and CS 2321

**CS 4331 - Introduction to Parallel Programming**

Introduction to developing parallel programs and solving problems using multiple concurrent processes. Shared memory and message passing paradigms are studied. Topics include conceptual models of parallel programming, basic analysis of parallel languages, parallel computer architecture, domain decomposition, and load balancing. Traditional computer science applications and numerical applications are also studied.

**Credits:** 3.0

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

**Semesters Offered:** On Demand

**Pre-Requisite(s):** CS 3331 and CS 3421 and CS 4321

**CS 4411 - Operating Systems**

Principles of the design and implementation of operating systems. Topics include: process management, process scheduling, memory management, I/O, file systems. Includes a significant implementation component.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** CS 3331 and CS 3421

**CS 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

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

**Pre-Requisite(s):** CS 2321

**CS 4431 - Computer Architecture**

Advanced course in architecture of high-performance computer systems. Topics include instruction-set design, simulation of processor architectures, multiple functional units, pipelining, dynamically scheduled pipelines, speculative execution, multi-core and multi-processor systems, advanced I/O subsystems and analytic models of architectural features of processors.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring

**Pre-Requisite(s):** CS 3421

**CS 4451 - Network Administration**

Administration of computer networks. Topics include: TCP/IP networking, mail, printing, configuring and building kernels, remote file systems, license management, managing web systems, common network administration services, and network performance analysis.

**Credits:** 4.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** CS 3451 and CS 4461(C)

**CS 4461 - Computer Networks**

Computer network architectures and protocols; design and implementation of datalink, network, and transport layer functions. Introduction to the Internet protocol suite (TCP, UDP, IP), domain name service and protocols, file sharing protocols, wireless networks, and network security.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** CS 3411 and CS 4321

**CS 4471 - Computer Security**

Development and administration of secure software systems. Topics include principles of software development, practical cryptography, program security, operating system security, database security, administration, legal and ethical issues.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** CS 3411 or CS 4411

**CS 4611 - Computer Graphics**

Introduction to interactive computer graphics. Topics include 3D viewing, 3D transformation, interactive techniques, animation, modeling, lighting, texturing, vertex programs, fragment programs, and graphics algorithms. Requires substantial programming homework.

**Credits:** 3.0

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

**Semesters Offered:** Fall

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

**Pre-Requisite(s):** CS 1141 and CS 2321 and MA 2330

**CS 4710 - Model-Driven Software Development**

Focuses on the use of formal models throughout the software development life cycle. Topics include formal specification of requirements, behavioral modeling, automated analysis, architectural styles and design specification.

**Credits:** 3.0

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

**Semesters Offered:** On Demand

**Pre-Requisite(s):** CS 3311 and CS 3141(C)

**CS 4711 - Software Processes and Management**

Focuses on the software development process and related management issues. Topics include software process models, the Capability Maturity Model, process tools, use of standards, software maintenance, configuration management, project planning and tracking, team management, and measurement and estimation.

**Credits:** 3.0

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

**Semesters Offered:** On Demand

**Pre-Requisite(s):** CS 3141

**CS 4712 - Software Quality Assurance**

Covers the notion of software quality and how to ensure quality through the software process. Topics include requirements elicitation, analysis and documentation; usability and accessibility; testing; and quality assurance management.

**Credits:** 3.0

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

**Semesters Offered:** On Demand

**Pre-Requisite(s):** CS 3141

**CS 4750 - Teaching Methods in Computer Science**

Provides teaching methods, models, and experiences for teaching computer science in secondary schools. Topics discussed include teaching methods, learning, security and maintenance of equipment, professional journals, ethics, legal issues, diversity, and problem solving. Requires admission to the Teacher Education Program.

**Credits:** 3.0

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

**Semesters Offered:** On Demand

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

**Pre-Requisite(s):** ED 4700

**CS 4760 - Human-Computer Interactions**

Principles of user interfaces (UI) design and implementation. Topics include: UI theory, design principles, evaluation, and tools. Requires completion of a group project implementing and evaluating a UI.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** CS 3141

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

**Pre-Requisite(s):** CS 2321 and CS 3311

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**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 3020 - 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 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 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 4050 - 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

**Pre-Requisite(s):** EC 2001

**EC 4100 - Mathematical Economics**

Application of the principal mathematical techniques used in economic theory and modeling. Topics include optimization, marginal analysis, comparative statics, and other applications.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** EC 3002 and EC 3003 and (MA 1160 or MA 1161 or MA 1135)

**EC 4200 - Econometrics**

Introduces techniques and procedures to estimate and test economic and financial relationships developed in business, economics, social and physical sciences.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** (EC 2001 or EC 3002 or EC 3003) and (BA 2100 or BUS 2100 or MA 2710 or MA 2720 or MA 3710) and (MA 1135 or MA 1160 or MA 1161)

**EC 4400 - Banking and Financial Institutions**

Analysis of asset and liability management of financial institutions and the role of financial institutions in the U.S. and international economy.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring

**Pre-Requisite(s):** EC 3003 or BA 3400 or FIN 3000

**EC 4500 - Public Economics**

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

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** EC 2001

**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 - Offered alternate years beginning with the 2001-2002 academic year

**Pre-Requisite(s):** EC 2001

**EC 4710 - Labor/Human Resource Economics**

Economic analysis of labor markets and human resources. Topics include the supply and demand for labor, wage determination, human capital theory, returns to education and training, causes of wage differentials, and economic effects of discrimination.

**Credits:** 3.0

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

**Semesters Offered:** On Demand

**Pre-Requisite(s):** EC 2001 and (BA 2100 or MA 2710 or MA 2720 or MA 3710)

**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

**Education****ED 2010 - Field Study in Education: Elementary School**

Observations in an elementary school, offering relevant school experience to help clarify career goals.

**Credits:** 1.0

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

**Semesters Offered:** Fall, Spring

**Restrictions:** Permission of department required

**ED 2020 - Field Study in Education: Secondary School**

Observations in a secondary school, offering relevant school experience to help clarify career goals.

**Credits:** 1.0

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

**Semesters Offered:** Fall, Spring

**Restrictions:** Permission of department required

**ED 3100 - Instructional Technology**

Provides the development of knowledge and skills required to make use of information and communication technologies as instructional tools. Use of instructional technology will be considered within a context of relevant research and theory pertaining to human learning. Examines various technologies used to produce, present, and distribute instruction.

**Credits:** 2.0

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

**Semesters Offered:** Fall, Spring, Summer

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

**ED 3110 - Psychological Foundations of Learning**

The course examines how human beings grow and learn with major emphasis on the early adolescent and adolescent. Psychological basis of educational procedures and practices are established with special reference to learning disorders, gifted children, and culturally diverse classrooms.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring

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

**ED 3210 - Foundations of Education**

Contemporary issues in education from historical, philosophical, sociological and legal perspectives. Emphasizes the structure/function of U.S. education as well as exceptional children, especially the handicapped and culturally different. This course is one component of the Teacher Education Early Block. Requires admission to teacher education program.

**Credits:** 2.0

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

**Semesters Offered:** Fall, Spring

**Restrictions:** Permission of department required; May not be enrolled in one of the following Class(es): Freshman

**Co-Requisite(s):** ED 3110, ED 3410

**Pre-Requisite(s):** ED 3110(C) and ED 3410(C)

**ED 3410 - Clinical Experience**

Observation, tutoring and classroom teaching in an area school classroom. 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

**Co-Requisite(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-Requisite(s):** ED 4700(C)

**ED 4140 - Methods of Teaching English**

Application of learning theories and national and state professional standards to the teaching of English. Emphasizes methods, materials, and media used to teach adolescents. Requires admission to teacher education program or permission of instructor.

**Credits:** 4.0

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

**Semesters Offered:** Fall

**Restrictions:** Permission of department required

**Pre-Requisite(s):** ED 4700(C)

**ED 4150 - Literacy in the Content Areas**

An introduction to the best ways to use language for deepening comprehension and understanding of all the content areas. Includes inquiries into how cultural and learning differences relate to comprehension. A minimum of 28 tutoring hours in a local school is required.

**Credits:** 4.0

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

**Semesters Offered:** Fall, Spring

**Pre-Requisite(s):** ED 3110 and ED 3210 and ED 3410

**ED 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**

Students identify and develop an in-depth examination of current topics in education for further research and study. Working in consultation and agreement with select faculty, students engage in active inquiry on leading educational issues.

**Credits:** variable to 6.0; Repeatable to a Max of 9

**Semesters Offered:** Fall, Spring

**ED 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

**Pre-Requisite(s):** ED 3110 and ED 3210 and ED 3410

**ED 4720 - Methods of Teaching Science**

Application of learning and instructional theories to the teaching of science.

**Credits:** 2.0

**Lec-Rec-Lab:** (1-0-2)

**Semesters Offered:** Fall, Spring

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

**Pre-Requisite(s):** ED 4700(C)

**ED 4750 - Teaching Methods in Computer Science**

Provides teaching methods, models, and experiences for teaching computer science in secondary schools. Topics discussed include teaching methods, learning, security and maintenance of equipment, professional journals, ethics, legal issues, diversity, and problem solving. Requires admissions to the Teacher Education Program.

**Credits:** 3.0

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

**Semesters Offered:** On Demand

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

**Pre-Requisite(s):** ED 4700

**ED 4850 - Environmental Education Methods**

This course will prepare students to design and conduct environmental education programs for adults and youth in classrooms, parks, museums, nature centers, and through statewide outreach programs using a variety of teaching methods, hands-on-activities, and scientific investigations.

**Credits:** 4.0

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

**Semesters Offered:** On Demand

**Restrictions:** 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 4720 or HU 4140 or SS 4020(C) or MA 4905)

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**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; Must be enrolled in one of the following Class(es): Freshman, Sophomore

**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:** Fall, Spring, Summer

**Restrictions:** Must be enrolled in one of the following Class(es): Sophomore

**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 2303 - 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

**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 2150 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:** Fall, Spring, Summer

**Restrictions:** May not be enrolled in one of the following Major(s): Electrical Engineering, Computer Engineering

**EE 3120 - Electric Energy Systems**

An overview of the generation and utilization of electrical energy. Covers three-phase circuits, transformers, photovoltaics, batteries, electromechanical energy conversion, and an overview of electric power systems, including economic issues.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring, Summer

**Pre-Requisite(s):** EE 2110 or EE 3010

**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 3010

**EE 3140 - Electromagnetics**

Covers basic principles of engineering electromagnetics with an emphasis on Maxwell's equations.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring

**Pre-Requisite(s):** PH 2200 and MA 3160 and EE 2110

**EE 3160 - Linear Systems and Control**

Introduces the mathematical analysis of signals, systems, and control. Topics include differential equations, Fourier series, Fourier transforms, Laplace transforms, frequency response, Bode plots, state models, and an introduction to control systems.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring, Summer

**Pre-Requisite(s):** EE 2150 and EE 2110 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

**Restrictions:** May not be enrolled in one of the following Major(s): Computer Engineering

**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 microprocessor or microcontroller-based systems, communication and bus protocols, programming in assembler language and in "C", system integration and testing. Also covers the use of FPGAs and HDL design tools.

**Credits:** 4.0

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

**Semesters Offered:** Fall, Spring

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

**Pre-Requisite(s):** EE 2304 and EE 3130 and (CS 1141 or CS 2141) and CS 3421 and (MA 3710 or EE 3180)

**EE 3180 - Introduction to Probability and Random Signal Analysis**

Probability density and distribution functions, expected value, correlation, and random vectors. Wide sense stationary random signals. The correlation function and spectral density. Random signals and noise in linear systems. An introduction to hypothesis testing and parameter estimation. Engineering applications.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring, Summer

**Pre-Requisite(s):** EE 3160

**EE 3190 - Optical Sensing and Imaging**

Optical sensing techniques, including imaging and non-imaging systems.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** EE 2190

**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:** (3-0-2)

**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

**Restrictions:** Must be enrolled in one of the following Major(s): Physics, Applied Physics, Electrical Engineering, Metallurgical & Materials Engr; Must be enrolled in one of the following Class(es): Junior, Senior

**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

**Restrictions:** Must be enrolled in one of the following Major(s): Electrical Engineering, Computer Engineering

**Pre-Requisite(s):** EE 2110 and EE 2304

**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

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

**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:** Permission of instructor required; Must be enrolled in one of the following Class(es): Junior, Senior

**EE 4173 - Computer System Architecture**

Covers the principles and practices of modern computer architecture. Emphasizes quantitative performance evaluation of: memory hierarchies, from cache through virtual memory; pipelined processors with advanced hazard management; and combined processor/memory systems. Introduces RAID, superscalars, parallel processing, cache coherence, performance simulation software.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring

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

**Pre-Requisite(s):** CS 3421 and EE 3173

**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:** (3-0-0)

**Semesters Offered:** Fall

**Pre-Requisite(s):** EE 3120

**EE 4222 - Power System Analysis 2**

Topics covered include symmetrical components; symmetrical faults; unbalanced faults; generating the bus impedance matrix and using it in fault studies; power system protection; power system operation; power system stability.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** EE 4221

**EE 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 primary system design, applications for capacitors, voltage drop, power loss, distribution system protection, and introduction to advanced distribution automation.

**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, power flow and fault simulations, relay settings and relay testing and calibration.

**Credits:** 1.0

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

**Semesters Offered:** Spring, Summer

**Restrictions:** Permission of instructor required

**Pre-Requisite(s):** EE 4221 and EE 4222(C)

**EE 4227 - Power Electronics**

Fundamentals of circuits for electrical energy processing. Covers switching converter principles for dc-dc, ac-dc, and dc-ac power conversion. Other topics include harmonics, pulse-width modulation, feedback control, magnetic components and power semiconductors.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** EE 3120

**EE 4228 - Power Electronics Lab**

Fundamentals of design, construction and control of circuits for electrical energy processing. Covers switching converter principles for dc-dc, ac-dc, and dc-ac power conversion. Other topics include harmonics, pulse-width modulation, feedback control, magnetic components and power semiconductors.

**Credits:** 1.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** EE 4227(C)

**EE 4231 - Physical Electronics**

Device physics and physical models of the most basic solid-state device structures. Major topics include the terminal characteristics and their physical origin, device design, and device applications.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** EE 3130

**EE 4232 - Electronic Applications**

Study of electronic circuits under small- and large-signal conditions. Typical topics include analysis and design of power and RF amplifiers, feedback circuits, oscillators, timing circuits, and wave-shaping circuits.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** EE 3130

**EE 4240 - Introduction to MEMS**

Fundamentals of micromachining and microfabrication techniques, including planar thin-film process technologies, photolithographic techniques, deposition and etching techniques, and the other technologies that are central to MEMS fabrication.

**Credits:** 4.0

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

**Semesters Offered:** Fall

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

**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 3160 and (MA 3720 or EE 3180)

**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:** (3-0-2)**Semesters Offered:** Fall**Pre-Requisite(s):** EE 2150 and EE 3160**EE 4253 - Real Time Signal Processing**

Practical implementation of digital signal processing concepts as developed in EE4252. Emphasis on applications of DSP to communications, filter design, speech processing, and radar. Laboratory provides practical experience in the design and implementation of DSP solutions.

**Credits:** 3.0**Lec-Rec-Lab:** (2-0-2)**Semesters Offered:** Spring**Pre-Requisite(s):** EE 4252**EE 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:** (3-0-0)**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; analysis of feedback control systems (stability, transient performance, steady-state error, disturbance rejection, control magnitude constraints, and robustness); cascade controller design using root locus and frequency response methods; digital simulation and computation; and experiments with physical systems.

**Credits:** 3.0**Lec-Rec-Lab:** (2-0-2)**Semesters Offered:** Fall**Pre-Requisite(s):** EE 3160**EE 4262 - Digital and Non-linear Control**

State space based control system design; digital control system design and analysis (Z-transforms, difference equations, and the discrete-time state model); introduction to nonlinear systems (equilibrium states, linearization, phase plane analysis, and describing function analysis); discrete-event controller design (state-transition techniques, relay ladder logic, and Petri nets); and experiments with physical systems.

**Credits:** 3.0**Lec-Rec-Lab:** (2-0-2)**Semesters Offered:** Spring**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:** (3-0-2)**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:** (3-0-0)**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 4295 - Introduction to Propulsion Systems for Hybrid Electric Vehicles**

Hybrid electric drive vehicle analysis will be developed and applied to examine the operation, integration, and design of powertrain components. Model based simulation and design is applied to determine vehicle performance measures in comparison to vehicle technical specifications. Power flows, losses, energy usage, and drive quality are examined over drive-cycles via application of these tools.

**Credits:** 3.0**Lec-Rec-Lab:** (0-3-0)**Semesters Offered:** Fall**Restrictions:** Must be enrolled in one of the following College(s): College of Engineering; May not be enrolled in one of the following Class(es): Freshman, Sophomore**Pre-Requisite(s):** (MEEM 2200 or ENG 3200) and MEEM 4700 or EE 4261**EE 4296 - Introduction to Propulsion Systems for Hybrid Electric Vehicle Laboratory**

Hybrid electric drive vehicles and their powertrain components will be examined from the aspects of safety, testing and analysis, energy conversion, losses, and energy storage, and vehicle technical specifications and vehicle development process. The lab will culminate with vehicle testing to perform power flow and energy analysis during a drive-cycle.

**Credits:** 2.0**Lec-Rec-Lab:** (0-1-2)**Semesters Offered:** Fall**Restrictions:** Must be enrolled in one of the following College(s): College of Engineering; May not be enrolled in one of the following Class(es): Freshman, Sophomore**Pre-Requisite(s):** MEEM 4295(C) or EE 4295(C)**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 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 from a quantum mechanical perspective.

**Credits:** 3.0**Lec-Rec-Lab:** (3-0-0)**Semesters Offered:** Spring**Pre-Requisite(s):** EE 3140**EE 4495 - Software/Hardware Design of Multimedia Systems**

A comprehensive overview of the design and implementation of the hardware and software of a platform for multimedia applications. Topics include system level design methodology, single-instruction-multiple data processor (SIMD), virtual platform implementation, development of an SIMD parallel compiler, and real-time operating systems. (RTOS).

**Credits:** 3.0**Lec-Rec-Lab:** (3-0-0)**Semesters Offered:** Spring**Restrictions:** Must be enrolled in one of the following Level(s): Graduate**Pre-Requisite(s):** CS 3411 and EE 4173



**EE 4496 - GPU and Multicore Programming**

Introduction to GPU and multi-cores, their architectural features and programming model, stream programming and unified driver architecture (CUDA), caching architectures, linear and non-linear programming, and scientific computing on GPUs, sorting and searching, stream mining, cryptography, fixed and floating point operations.

**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):** CS 3411 and EE 4173

**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 3173 or EE 4431 or CS 4431 or EE 4173

**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 4750 - Distributed Embedded Control Systems**

This course will develop an understanding for the design and application of embedded control systems. Topics to be covered include: embedded system architecture, model-based embedded system design, real-time control, communication protocols, signal processing, and human machine interface. Embedded applications in advanced hybrid electric vehicles will also be introduced.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Restrictions:** Must be enrolled in one of the following College(s): College of Engineering

**Pre-Requisite(s):** MEEM 4700 or EE 4261

**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 - EE Design Project 1**

The first semester of a program of study in which a group of students work on an engineering design project in consultation with a faculty member. (Senior project ready as defined by major substitutes for prerequisites)

**Credits:** 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):** EE 4900

**Pre-Requisite(s):** (EE 3305 or EE 3173) and (EE 3130 or EE 4431 or EE 4173) and EE 4900(C)

**EE 4910 - EE Design Project 2**

The second semester of a program of study in which a group of students work on an engineering design project in consultation with a faculty member. (Senior project ready as defined by major substitutes for prerequisites)

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** EE 4901

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## Electrical Engineering Technology

**EET 1120 - Circuits I**

Defines resistance, voltage, current, energy, and power, followed by DC network analysis and network theorems. Includes the analysis of transients in capacitive and inductive networks. Lab exercises use electronic test equipment to analyze circuits constructed from schematics.

**Credits:** 4.0

**Lec-Rec-Lab:** (0-3-2)

**Semesters Offered:** 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 devices including DC and AC circuits, diodes, transistors, operational amplifier ICs, power supply regulation, and elements of communication systems.

**Credits:** 4.0

**Lec-Rec-Lab:** (0-3-2)

**Semesters Offered:** Fall, Spring

**Restrictions:** Must be enrolled in one of the following Major(s): Surveying Engineering, Mechanical Engineering Tech, Computer Network & System Admn, Industrial Technology

**Pre-Requisite(s):** MA 1031 or MA 1032 or MA 1160(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:** Spring

**Pre-Requisite(s):** MA 2160(C)

**EET 2120 - Circuits II**

Defines and applies sinusoidal steady-state AC concepts such as impedance, complex power, resonance, and frequency response. Applies basic network analysis tools to AC single phase and balanced three-phase networks, bridge circuits, and filters. AC circuit principles are reinforced by coordinated lab exercises.

**Credits:** 4.0

**Lec-Rec-Lab:** (0-3-2)

**Semesters Offered:** Fall

**Pre-Requisite(s):** EET 1120 and (MA 1160(C) or MA 1161(C) or MA 1135(C))

**EET 2141 - Digital Electronics and Microprocessor Fundamentals**

A study of the fundamental components used in digital logic circuits and microcomputer architecture and programming. Topics include: number systems and codes, Boolean algebra, combinational logic circuits, flip-flops, arithmetic circuits, counters and registers, decoders, multiplexers, memory organization, microcomputer addressing modes, stacks and subroutines.

**Credits:** 4.0

**Lec-Rec-Lab:** (0-3-2)

**Semesters Offered:** Fall

**Pre-Requisite(s):** EET 1120 or EET 1411

**EET 2142 - Digital Design and Modeling Using VHDL**

Emphasizes the language concepts of digital systems design using VHDL with emphasis on good design practices and writing verification testbenches. Students will gain valuable hands-on experience writing efficient hardware design code and performing simulations using ModelSim.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** EET 2141

**EET 2220 - Electronic Devices & Circuits**

Introduction to solid-state electronic devices and their application. Studies diodes, transistors and operational amplifier ICs. Transistor biasing, temperature stabilization and gain calculations of single and multistage amplifiers. Studies power amplifiers, frequency response, heat sinking and power supply design.

**Credits:** 4.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** EET 2120

**EET 2233 - Electrical Machinery**

Fundamental steady-state analysis of DC, AC polyphase and AC single-phase electrical machines as well as transformers.

**Credits:** 4.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** EET 1411 or EET 2120(C)

**EET 2241 - C++ and Matlab Programming**

Introduction to C++ programming and MATLAB for use in solving problems encountered in engineering technology. C++ topics include the basics of syntax and program structure. Focuses on the basic capabilities of MATLAB and its programming environment.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring

**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, and digital memory.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**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 data communication methods. Topics include data transmission, signal encoding techniques, digital data communication techniques, transmission media, and frequency domain analysis.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Restrictions:** Must be enrolled in one of the following Major(s): Electrical Eng Tech (BS), Computer Network & System Admn

**Pre-Requisite(s):** EET 1411 or EET 1120

**EET 3131 - Instrumentation**

An investigation of transducers and where they are used. Topics include signal conditioning, sensitivity, linearity, hysteresis, process measurements, and position, motion and force measurements. Exposure to graphical data acquisition tools such as LabVIEW is incorporated.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-2-3)

**Semesters Offered:** Spring

**Pre-Requisite(s):** EET 1411 or EET 2220 or PH 2230 or EE 2110 or EE 3010

**EET 3141 - Computer Architecture and Design**

Computer system components, instruction set design, hardwired control units, arithmetic algorithms/circuits, floating-point operations, introduction to memory and I/O interfaces.

**Credits:** 4.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** EET 2241 and EET 2142(C)

**EET 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:** Fall

**Pre-Requisite(s):** EET 3141

**EET 3143 - Programmable Logic Devices**

Emphasizes the concept of design, simulation and implementation of large scale digital systems which incorporate digital devices at all complexity levels.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-2-3)

**Semesters Offered:** Fall, Spring

**Pre-Requisite(s):** EET 3141

**EET 3225 - Special Electronic Devices**

An advanced course in the study of linear integrated circuits. Includes op amps, comparators, wave form generators, timers and regulators. Emphasizes practical applications, including the interface of time-continuous measures to the discrete digital world.

**Credits:** 4.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** EET 2220

**EET 3281 - Electrical Project Development and Troubleshooting**

Covers soldering, component layout, printed circuit board artwork, troubleshooting, electrical and environmental factors in design as well as an overview of the practical methods used by industry to process projects. The student designs and fabricates a circuit board and assembles a project.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** EET 2220

**EET 3367 - Communication Systems**

Basic course in communication systems. Topics include noise designation and calculation, bandwidth, frequency domain analysis, oscillators, AM/FM analysis, AM/FM transmission and reception, superheterodyne principle, and SSB.

**Credits:** 4.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** EET 3225

**EET 3373 - Introduction to Programmable Controllers**

The design of discreet sequential controls using programmable logic controllers (PLCs). Relay logic is used to introduce ladder logic and ladder logic is used to program the PLC. Introduces a structured approach to sequential control design. Data acquisition is introduced using BridgeVIEW software.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-2-3)

**Semesters Offered:** Fall

**Pre-Requisite(s):** EET 1411 or (EET 2120 and EET 2141) or EET 2411 or PH 2230 or EE 2110 or EE 3010

**EET 3390 - Power Systems**

A study of the distribution of electrical power from substations to loads, system components and system performance. Covers basics of power systems and their analysis, the per-unit concept, faults on power circuit interrupting, system instrumentation, and automatic protection system.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** EET 2233

**EET 3412 - Introduction to Optical Fiber Communication Systems**

Focuses on the basic principles of optical fiber communications, including wave propagation, optical fiber, optical transmitters and receivers, signal processing, analysis of system impairments, and optical networks.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Restrictions:** Must be enrolled in one of the following Major(s): Electrical Eng Tech (BS), Computer Network & System Admn; Must be enrolled in one of the following Class(es): Junior, Senior

**Pre-Requisite(s):** EET 2413



**EET 4141 - Microcomputer Interfacing**

The design of systems, hardware, and software needed to perform serial and parallel data transmission between microcomputers. Data collection using analog to digital converters, and analog and digital control outputs.

**Credits:** 4.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** EET 2141 or CS 1121

**EET 4142 - Digital Signal Processing Applications**

Provides students with knowledge in architecture, instruction set, hardware and software development tools associated with a fixed point general purpose DSP. Includes applications of DSP in control of electric drives and power electronic devices.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-2-3)

**Semesters Offered:** Spring

**Pre-Requisite(s):** EET 3367 and EET 4141

**EET 4144 - Real-Time Robotics Systems**

Covers the components of a robot system, safety, concepts of a work-cell system, geometry, path control, automation sensors, programming techniques, hardware, and software.

**Credits:** 4.0

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

**Semesters Offered:** On Demand

**Pre-Requisite(s):** EET 1411 or EET 2220 or PH 2230 or EE 2110 or EE 3010

**EET 4145 - VLSI Circuits Design**

VLSI design methodology; specification of VLSI circuits at various levels of abstraction; design, layout, and computer simulation of circuits; high-level synthesis; design projects.

**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):** EET 2220

**EET 4146 - Functional Verification of Hardware Design**

Techniques for verification of hardware designs; writing testbenches, verifications of increasingly complex hardware systems, circuit designs provided by industry using simulation environments commonly used in industry.

**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):** EET 3143

**EET 4253 - LabVIEW Programming for Data Acquisition**

An introduction to graphical programming using LabVIEW. Data acquisition and control programs will be written. Transducer utilization and signal conditioning are studied, including handling of noise. DAQ interfaces will be designed, built, and implemented.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-2-3)

**Semesters Offered:** Spring

**Pre-Requisite(s):** EET 1411 or EET 2220 or EE 2110 or EE 3010 or PH 2230

**EET 4311 - Advanced Circuits and Controls**

This course considers the modeling, design and implementation of basic and advanced process control strategies. Process modeling and dynamics will be considered using LaPlace transform analysis. Control techniques addressed will include feedback, cascade, feedforward, multivariable and model based methods.

**Credits:** 4.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** EET 3131 or EET 4253

**EET 4367 - Wireless Communications**

Topics include television systems, wave propagation, antennas, digital communications, wireless communications systems and standards, wireless communications channels, multiple access schemes, modern wireless technologies, wireless channel impairments and techniques to minimize them.

**Credits:** 4.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** EET 3367 and MA 2160

**EET 4368 - Optics Fundamentals for Technologists**

Assimilation of optics concepts will prepare the technologist to converse with optical professionals in the workplace whenever consulting might be required. Simulation tools for modeling and laboratory experiments will provide hands-on experience working with practical optical systems.

**Credits:** 3.0

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

**Semesters Offered:** On Demand

**EET 4373 - Advanced Programmable Controllers**

Using Allen Bradley Micro Logix, SLC500, & PLC-5 programmable controllers, course covers structured programming, Sequential Function Charts, networking, proportional integral differential control, data acquisition and interfacing. The labs will require students to write and troubleshoot complex PLC programs.

**Credits:** 4.0

**Lec-Rec-Lab:** (0-2-3)

**Semesters Offered:** Spring

**Pre-Requisite(s):** EET 3373

**EET 4390 - Power Transmission and Alternative Energy**

Concepts of power transmission are examined in detail. Alternative energy sources such as wind, solar, and tidal are discussed. The idea of interconnecting the alternative energy with the transmission grid is also covered.

**Credits:** 3.0

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

**Semesters Offered:** On Demand

**Pre-Requisite(s):** EET 3390

**EET 4391 - Power Electronics Fundamentals**

Fundamentals of electronic power conversion circuits and devices. Analyzes basic switching circuits and power converter topologies including dc/dc converters, ac/dc rectifiers, and dc/ac inverters. Discusses the selection criteria for reactive elements and models for solid-state switching devices.

**Credits:** 4.0

**Lec-Rec-Lab:** (0-3-2)

**Semesters Offered:** On Demand

**Pre-Requisite(s):** EET 2220

**EET 4460 - Senior Project I**

Capstone course phase I, requiring the application of knowledge gained in lower division courses. Projects are normally team oriented, require weekly progress reports, and culminate with a final report and oral presentation.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-1-2)

**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:** (0-1-2)

**Semesters Offered:** Fall, Spring, Summer

**Restrictions:** Must be enrolled in one of the following Class(es): Senior

**Pre-Requisite(s):** EET 4460

**EET 4996 - Special Topics in Electrical Engineering Technology**

Selected additional topics of interest in Electrical Engineering Technology based on student and faculty demand and interest. May be a tutorial, seminar, workshop, project, or class study.

**Credits:** variable to 3.0; Repeatable to a Max of 6

**Semesters Offered:** On Demand

**Restrictions:** Permission of instructor required; Must be enrolled in one of the following Major(s): Electrical Eng Tech (BS); Must be enrolled in one of the following Class(es): Senior

**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

**EET 4998 - Undergraduate Research in Electrical Engineering Technology**

An undergraduate research experience in Electrical Engineering Technology. Under the guidance of an Electrical 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): Electrical Eng Tech (BS); Must be enrolled in one of the following Class(es): Senior

**EET 4999 - Professional Practice Seminar**

A review of the latest developments in electrical engineering technology.

**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 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 1010 - Introduction to Sports and Fitness Management

Introduction to the fields and career opportunities in sports and fitness management.

**Credits:** 1.0

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

**Semesters Offered:** Fall

### EH 1500 - Foundations of Kinesiology

Introduces academic subdisciplines of kinesiology - anatomy, motor behavior, biomechanics, physiology, exercise and the environment, sport nutrition and the mind and brain in exercise. Provides the conceptual framework within which the scientific bases for movement during exercise, sport performance, and other forms of physical activity are studied.

**Credits:** 3.0

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

**Semesters Offered:** Spring

### EH 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 2050 - Sports and Fitness Leadership

Course is designed to be a leadership course for those students interested in learning how to teach fitness classes in a variety of settings. Modalities of group exercise will include weight training, kickboxing, step aerobics, high/low impact aerobics, and circuit station workouts. Topics will include safety, risk rating clients, monitoring exercise intensity, cueing, transitions, music tempo, choreography, and leadership skills. Students will perform a teaching segment to their peers.

**Credits:** 3.0

**Lec-Rec-Lab:** (2-0-1)

**Semesters Offered:** Fall

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

**Pre-Requisite(s):** EH 1500

### 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

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

### 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 2800 - Health Promotion and Wellness

This course emphasizes methods in planning, designing, implementing, and improving health/wellness promotion programs. Client motivation, behavior change, and physical activity for special populations will be addressed.

**Credits:** 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):** EH 1500

### EH 3000 - Master Student Athlete

Read, discuss, and practice study skills, cognitive strategies, goal development, and address contemporary issues problematic in today's college environment.

**Credits:** 1.0

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

**Semesters Offered:** Fall

**Restrictions:** Permission of department required

### EH 3010 - Sports Psychology

Overview of psychological principles and their applications to individuals and groups in sport, exercise and/or therapy. For the laboratory portion, students observe and analyze behaviors in a setting of their choice.

**Credits:** 3.0

**Lec-Rec-Lab:** (2-0-1)

**Semesters Offered:** Fall, Spring, 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 3070 - Sports Administration

Students will learn skills and competencies of sports management including ethics, marketing, law, finance, information, collegiate, olympic, professional, youth, campus recreation programs, parks, career opportunities, foundations, and future directions.

**Credits:** 2.0

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

**Semesters Offered:** Spring - Offered alternate years beginning with the 2011-2012 academic year

### EH 3080 - Facilities & Events Management

Students will learn about managing sports facilities including risk management, administration of personnel, organization, and administrative efficiency.

**Credits:** 2.0

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

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

### EH 3090 - Fitness Operations

This course provides instruction on the management aspects of fitness in health clubs and wellness settings. Topics will include staff training and supervision, scheduling, participant assessment, equipment selection, professional responsibilities, and program review.

**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

**Pre-Requisite(s):** EH 1500 and EH 2050

### 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 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 3690 - Medical First Responder**

The first responder course develops emergency medical skills and knowledge that will enable students to assist people who have sustained injury or sudden illness. As the initial level in pre-hospital care, response includes emergency first aid and patient assessment.

**Credits:** 1.0

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

**Semesters Offered:** Fall

**Restrictions:** Permission of department required

**Co-Requisite(s):** PE 1690

**EH 3700 - Lifetime Fitness**

To gain a thorough understanding in all areas of personal fitness through functional anatomy, exercise physiology, health and physical fitness, screening and evaluation, nutrition, weight management, exercise prescription and programming considerations, training instruction, and consideration for special populations.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Summer - 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:** 3.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** BL 2010 and BL 2011

**EH 3820 - Personal Training**

A pragmatic course of both theory and application in setting up a personal training program for individuals. Includes assessment, techniques, planning, safety and legal issues. Leads toward final preparation to earn certification as a personal trainer.

**Credits:** 2.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** BL 2010 and BL 2011

**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 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 4100 - Coaching Practicum**

Students seeking coaching endorsement assist with a sport of their choice. Subject to approval of endorsement advisor, students may assist a head coach in season during student teaching; assist MTU head coach in season; assist head coach in season at public/private school or summer camp.

**Credits:** 2.0

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

**Semesters Offered:** Fall, Spring, Summer

**Restrictions:** Permission of instructor required

**Pre-Requisite(s):** (EH 3010 or EH 4010) and (EH 3020 or EH 4020)

**EH 4200 - Sports Nutrition Seminar**

Human nutrition as it specifically applies to athletes. Specific needs for proteins, carbohydrates, fats, electrolytes and micronutrients. Use of ergogenic aids is covered. Students will research, write and present orally their findings on nutrition topics.

**Credits:** 2.0

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

**Semesters Offered:** Fall, Spring

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

**Pre-Requisite(s):** BL 2940

**EH 4210 - Exercise Physiology**

Focuses on the functional changes brought by acute and chronic exercise sessions. Topics include muscle structure and function, bioenergetics, cardiovascular and respiratory adaptations, exercise training for sport, sport nutrition, ergogenic aids, and other health and fitness topics.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Co-Requisite(s):** EH 4211

**Pre-Requisite(s):** BL 2020 and BL 2021

**EH 4211 - Exercise Physiology Laboratory**

A companion course to EH4210. Hands-on experience in making physiological measurements as related to exercise. Cardiovascular and respiratory changes during exercise will be monitored. A virtual lab is used to simulate changes in physiological measurements that cannot be performed on live subjects. A student designed laboratory project is required.

**Credits:** 1.0

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

**Semesters Offered:** Fall

**Co-Requisite(s):** EH 4210

**EH 4400 - Motor Learning and Control**

Designed for upper level undergraduates or graduates, this course will provide the current theories and concepts involved in the processes of motor skill acquisition and performance from a behavioral perspective.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** EH 1500 and BL 2020

**EH 4420 - Motor Development**

Designed for upper level undergraduates or graduates, this course will focus on the changes in motor behavior across a life span, and examine the study and practice of fundamental patterns within the context of development theory.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** EH 1500 and BL 2020

**EH 4500 - Biomechanics of Human Movement**

An in-depth view of the biomechanical properties of the musculoskeletal system. The course provides detailed analyses of the kinetics of human movement, material properties of the component tissues, and dynamic processes of adaptation to stress and strain of the system.

**Credits:** 3.0

**Lec-Rec-Lab:** (2-0-1)

**Semesters Offered:** Fall

**Pre-Requisite(s):** BL 2020 and EH 1500 and PH 1110 and PH 1111

**EH 4600 - Sports and Fitness Marketing**

Development and implementation of marketing plans for sports and fitness businesses. Topics include marketing of sporting events and fitness programs, use of traditional media for promotion, web-based advertising (new media), and business branding.

**Credits:** 2.0

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

**Semesters Offered:** Fall - Offered alternate years beginning with the 2011-2012 academic year

**Pre-Requisite(s):** MKT 3000 or BA 3800

**EH 4620 - Legal Issues in Sports and Fitness Management**

Review of legal issues that apply to sport and fitness organizations such as liability, risk management, facility concerns, and labor laws. Basic components of the U.S. legal system and guidelines, and rules of the National Collegiate Athletic Association will be covered.

**Credits:** 2.0

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

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

**EH 4800 - Internship in Sports and Fitness Management**

Empirical experiences in an approved internship site. Provides practical experience in one or more work settings, assisting the upper level student in making an appropriate career choice. Internships must be approved by the department internship coordinator and work 40 hours for each credit earned.

**Credits:** variable to 12.0; Repeatable to a Max of 12

**Semesters Offered:** Fall, Spring, Summer

**Restrictions:** Permission of department required; Must be enrolled in one of the following Major(s): 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, Health and Physical Education; May not be enrolled in one of the following Class(es): Freshman, Sophomore

**EH 4950 - Special Topics in Physical Activity**

Only open to Health and Physical Education majors. Departmental approval necessary.

**Credits:** variable to 9.0; Repeatable to a Max of 9

**Semesters Offered:** Fall, Spring, Summer

**Restrictions:** Permission of department required; Must be enrolled in one of the following Major(s): Exercise Science, Health and Physical Education

**EH 4990 - Special Topics in Exercise Science**

Examination of current topics in the field of exercise science. Literature and research topics are addressed.

**Credits:** variable to 9.0; Repeatable to a Max of 9

**Semesters Offered:** Fall, Spring, Summer

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

## Engineering Fundamentals

**ENG 1001 - Engineering Problem Solving**

Introduction to the engineering problem solving method and to modern tools used to solve problems.

**Credits:** 2.0

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

**Semesters Offered:** Fall, Summer

**Pre-Requisite(s):** (MA 1031(C) or MA 1032(C)) and (Spatial Visualization Score  $\geq$  19 or ENG 1002(C))

**ENG 1002 - Introduction to 3-D Spatial Visualization**

Intended for first-year engineering students with a demonstrated need for the development of 3-D spatial visualization skills. Topics include isometric sketching, orthographic projection, object transformations, 3-D coordinate systems, patterns folding to 3-D objects, and cross sections of solids.

**Credits:** 1.0

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

**Semesters Offered:** Fall, Spring

**ENG 1003 - Introduction to Computer Aided Drafting**

Fundamentals of creating engineering drawings with modern CAD software. Topics include basic geometric construction, drawing modification, dimensioning, and working with layers. Designed for students with no CAD experience.

**Credits:** 1.0

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

**Semesters Offered:** Spring

**Restrictions:** Must be enrolled in one of the following Class(es): Freshman, Sophomore

**Pre-Requisite(s):** ENG 1002 or ENG 1100 or ENG 1101

**ENG 1100 - Engineering Analysis**

An introduction to the engineering profession. Focuses on engineering analysis, computational skills, and communication skills.

**Credits:** 2.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** ENG 1001 and (MA 1160(C) or MA 1161(C))

**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  $\geq$  19 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):** (MA 1160 or MA 1161) and (ENG 1101 or (ENG 1001 and ENG 1100) and (Spatial Visualization Score  $\geq$  19 or ENG 1002))

**ENG 1990 - Special Topics in Engineering**

Engineering topics of interest to students and faculty that are not normally covered in the existing courses.

**Credits:** variable to 5.0; Repeatable to a Max of 6

**Semesters Offered:** On Demand

**ENG 2120 - Statics-Strength of Materials**

The composition and resolution of forces and force systems, principles of equilibrium applied to various bodies, simple structures, friction, and 2nd moments of area. Intro to the mechanical behavior of materials, including calculation of stresses, strains, and deformations due to axial, torsional, and flexural loading.

**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 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 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:** Spring

**Pre-Requisite(s):** PH 2100 and CH 1112 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:** Spring

**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

**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 2960 - 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 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 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:** Must be enrolled in one of the following Class(es): Junior, Senior

**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, Geological 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 ENG2962, students will learn and practice strategies for effective oral and written communications in technical and professional settings. Emphasis is on audience adaptation of technical information and on achieving clearly specified purposes.

**Credits:** 1.0

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

**Semesters Offered:** 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 Gantt and PERT/CPM charts; resource management and application of critical chain method; project budgeting and cost estimation; project monitoring, control, evaluation, and termination; and project 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

**ENT 3966 - Design for Manufacturing**

This course supplements courses that address "design for function." Products "designed for manufacturing" are lower cost, higher quality, and have a shorter time to market. The course describes how the capabilities and limitations of common manufacturing processes translate into qualitative design guidelines. Topics include design for casting, forging, sheet metal forming, machining, plastics and assembly.

**Credits:** 1.0

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

**Semesters Offered:** Spring

**Restrictions:** Must be enrolled in one of the following Class(es): Junior, Senior

**Pre-Requisite(s):** ENG 1102

**ENT 3967 - 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:** (1-0-0)

**Semesters Offered:** Fall

**Pre-Requisite(s):** 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 matrixes, 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

**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

**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 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 4310 - Practical Scanning Probe Microscopy for Undergraduates**

In this course, students will learn the design and fundamental physics behind scanning probe microscopy (SPM) techniques. Laboratories will include basic training in the operation of SPM instruments available at MTU, and the exploration of their capabilities during assigned team projects.

**Credits:** 1.0

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

**Semesters Offered:** On Demand - Offered alternate years beginning with the 2010-2011 academic year

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

**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, Summer

**Restrictions:** May not be enrolled in one of the following College(s): College of Engineering; Must be enrolled in one of the following Class(es): Senior

**ENT 4910 - Senior Enterprise Project Work 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:** 2.0  
**Lec-Rec-Lab:** (0-0-6)  
**Semesters Offered:** Fall, Spring, Summer  
**Restrictions:** Permission of department required; Must be enrolled in one of the following 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 Engrg, Biomedical Engineering, Computer Engineering; Must be enrolled in one of the following Class(es): Senior  
**Pre-Requisite(s):** (BE 3500(C) and BE 3600 and BE 3750 or MEEEM 4180) or (CE 3331 or CE 3620 and CE 3810) or CM 4855(C) or (CS 4710 or CS 4711 or CS 4712) or (EE 3173 or EE 3305) and EE 3173 or EE 3130 or EE 4431 or (MEEEM 3000(C) and MEEEM 3900) or (MY 3110 and MY 3200 and MY 3210 and MY 3300 and MY 3410)

**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 settings. Emphasizes creating 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.  
**Credits:** 1.0; Repeatable to a Max of 2  
**Lec-Rec-Lab:** (0-0-3)  
**Semesters Offered:** Fall, Spring, Summer  
**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

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## Environmental Engineering

**ENVE 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

**ENVE 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 1112 or (CH 1150 and CH 1151)

**ENVE 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 1112 or (CH 1150 and CH 1151)

**ENVE 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 1112 or (CH 1150 and CH 1151)

**ENVE 4501 - Environmental Engineering Chemical Processes**  
Application of chemistry, 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 engineering design. Laboratory experiences illustrate principles and modern measurement.  
**Credits:** 4.0  
**Lec-Rec-Lab:** (0-3-3)  
**Semesters Offered:** Fall  
**Pre-Requisite(s):** (ENVE 3501 or ENVE 3503) and ENVE 3502 and (CH 3500(C) or CH 3501(C))

**ENVE 4504 - Air Quality Engineering and Science**  
Overview of air quality regulation in the U.S. and world, including basic concepts of atmospheric chemistry and transport; fugitive, point, and area emissions; principles and tradeoffs of operation and design of air pollution control systems; and application of air quality models.  
**Credits:** 3.0  
**Lec-Rec-Lab:** (0-3-0)  
**Semesters Offered:** Fall  
**Pre-Requisite(s):** ENVE 3501 or ENVE 3503

**ENVE 4505 - Surface Water Quality Engineering**  
Develops the scientific basis for water quality management in lakes and rivers. Considers the origin, behavior, and fate of nutrients and toxic substances. Introduces engineered approaches for lake management, including mass balance modeling. Presents techniques for water quality restoration and the legal framework supporting pollution control.  
**Credits:** 3.0  
**Lec-Rec-Lab:** (0-2-3)  
**Semesters Offered:** Fall  
**Pre-Requisite(s):** ENVE 3501 or ENVE 3503



**ENVE 4506 - Application of Sustainability Principles & 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):** ENVE 3501 or ENVE 3503

**ENVE 4507 - Water Distribution and Wastewater Collection Design**

Application of basic principles in civil and environmental engineering to the analysis and design of water distribution systems, wastewater collection systems, and their appurtenances.

**Credits:** 3.0

**Lec-Rec-Lab:** (2-0-1)

**Semesters Offered:** Spring

**Pre-Requisite(s):** (ENVE 3501 or ENVE 3503) and CE 3620

**ENVE 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):** (ENVE 3501 or ENVE 3503) and (ENG 3200 or ENG 3507)

**ENVE 4509 - Environmental Process & Simulation**

Provides a rigorous hands-on introduction to process control, laboratory and pilot-plant experimentation focused on physical, chemical and biological treatment systems used in environmental engineering.

**Credits:** 2.0

**Lec-Rec-Lab:** (0-0-5)

**Semesters Offered:** Spring

**Pre-Requisite(s):** (ENVE 3501 or ENVE 3503) and CE 3620 and ENVE 4501 and ENVE 4508

**ENVE 4510 - Baccalaureate Thesis**

Independent baccalaureate research project performed under the supervision of one or more faculty.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring

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

**ENVE 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

**ENVE 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):** ENVE 4501 and ENVE 4508

**ENVE 4515 - Atmospheric Chemistry**

Study of the photochemical processes governing the composition of the troposphere and stratosphere, with application to air pollution and climate change. Covers radical chain reaction cycles, heterogeneous chemistry, atmospheric radiative transfer, and measurement techniques for atmospheric gases.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Restrictions:** Must be enrolled in one of the following Class(es): Senior

**Pre-Requisite(s):** (ENVE 4504 and ENVE 4501) or (CH 3510 and CH 3520(C))

**ENVE 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 2010-2011 academic year

**Restrictions:** Must be enrolled in one of the following Class(es): Senior

**Pre-Requisite(s):** CH 3510 or ENVE 4501(C)

**ENVE 4930 - Environmental Engineering Independent Study**

Approved research or design project in environmental engineering, originating with an individual student or assigned by the instructor.

**Credits:** variable to 3.0; Repeatable to a Max of 3

**Semesters Offered:** Fall, Spring, Summer

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

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## 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; Graded Pass/Fail Only

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

**Semesters Offered:** Fall, Spring

**Restrictions:** Permission of department required

**ESL 0220 - High Beginning Writing**

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:** 3.0; Graded Pass/Fail Only

**Lec-Rec-Lab:** (0-2-3)

**Semesters Offered:** Fall, Spring

**Restrictions:** Permission of department required

**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

**Restrictions:** Permission of department required

**ESL 0240 - High Beginning Communicative Grammar**

For students of English as a second language; not for native speakers of English. A grammar-based approach utilizing communicative methods to develop all skills. Focus is on past, present, future tenses; introduce modals; articles; nouns; pronouns; modifiers; possessives; comparisons.

**Credits:** 1.0; Graded Pass/Fail Only

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

**Semesters Offered:** Fall, Spring

**Restrictions:** Permission of department required

**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 0298 - 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; Graded Pass/Fail Only

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

**Semesters Offered:** Fall, Spring

**Pre-Requisite(s):** ESL 0210 and ESL 0220 and ESL 0230 and ESL 0240

**ESL 0320 - Intermediate Writing**

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:** 3.0; Graded Pass/Fail Only

**Lec-Rec-Lab:** (0-2-3)

**Semesters Offered:** Fall, Spring

**Pre-Requisite(s):** ESL 0210 and ESL 0220 and ESL 0230 and ESL 0240

**ESL 0330 - Intermed. Listening/Speaking**

For students of English as a second language, not for native speakers of English. Emphasis is on pronunciation and conversation, including rhythms, stress, and intonation; provides practice in social and academic English conversation using American culture as content.

**Credits:** 4.0; Graded Pass/Fail Only

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

**Semesters Offered:** Fall, Spring

**Pre-Requisite(s):** ESL 0210 and ESL 0220 and ESL 0230 and ESL 0240

**ESL 0340 - Intermediate Communicative Grammar**

For students of English as a second language; not for native speakers of English. A grammar-based approach utilizing communicative methods to develop all skills. Focus is on perfect tenses, questions, modals, conjunctions, passive voice, clauses, gerunds, infinitives.

**Credits:** 1.0; Graded Pass/Fail Only

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

**Semesters Offered:** Fall, Spring

**Pre-Requisite(s):** ESL 0210 and ESL 0220 and ESL 0230 and ESL 0240

**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; Graded Pass/Fail Only

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

**Semesters Offered:** Fall, Spring

**Pre-Requisite(s):** ESL 0310 and ESL 0320 and ESL 0330 and ESL 0340

**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; 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 and ESL 0340

**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 mathematic courses.

**Credits:** 1.0; 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 and ESL 0340

**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; 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 and ESL 0340

**ESL 0420 - Advanced Writing**

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:** 3.0; Graded Pass/Fail Only

**Lec-Rec-Lab:** (0-2-3)

**Semesters Offered:** Fall, Spring

**Pre-Requisite(s):** ESL 0310 and ESL 0320 and ESL 0330 and ESL 0340

**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; Graded Pass/Fail Only

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

**Semesters Offered:** Fall, Spring

**Pre-Requisite(s):** ESL 0310 and ESL 0320 and ESL 0330 and ESL 0340

**ESL 0440 - Advanced Communicative Grammar**

For students of English as a second language; not for native speakers of English. A grammar-based approach utilizing communicative methods to develop all skills. Focus on perfect and progressive tenses, agreement, modals, passive, clauses, conjunctions, conditionals.

**Credits:** 1.0; Graded Pass/Fail Only

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

**Semesters Offered:** Fall, Spring

**Pre-Requisite(s):** ESL 0310 and ESL 0320 and ESL 0330 and ESL 0340

**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; Graded Pass/Fail Only

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

**Semesters Offered:** Fall, Spring

**Restrictions:** Permission of department required

**Pre-Requisite(s):** ESL 0410 and ESL 0420 and ESL 0430 and ESL 0440

**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; Graded Pass/Fail Only

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

**Semesters Offered:** Fall, Spring

**Restrictions:** Permission of department required

**Pre-Requisite(s):** ESL 0410 and ESL 0420 and ESL 0430 and ESL 0440

**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 0498 - 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:** 5.0; Graded Pass/Fail Only

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

**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

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## Visual and Performing Arts

**FA 1010 - Film/Video/Stage Practicum I**

Introductory level course intended to introduce performance students to the professional performance process in film, video, or stage production. Students must audition for and be cast in an approved production. See FA2660 for non-majors.

**Credits:** 1.0

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

**Semesters Offered:** Fall, Spring

**Restrictions:** Permission of instructor required

**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:** (0-0-2)

**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:** (0-0-2)

**Semesters Offered:** Spring

**FA 1701 - Backstage Technology**

Overview of the basic techniques, theories, and terminology of technical theatre. Focus on practical application of stagecraft and rigging for a theatrical production, safety in technical theatre, physical theatre structures, production processes, and theatre organization.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring

**FA 1702 - Lighting and Sound Technology**

Overview of the basics of theatrical lighting, stage 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**

Intermediate level performance course wherein students experience the professional working process for a film, video, or theatrical production. Students must audition for and be cast in a leading role in an approved production. See FA2660 for non-majors.

**Credits:** 1.0

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

**Semesters Offered:** Fall, Spring

**Restrictions:** Permission of instructor required; Must be enrolled in one of the following Major(s): Theatre & Electr. Media Perf.

**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 2112 - Acoustic and Electronic Music Composition**

Explores the art of contemporary acoustic and electronic composition providing students with hands on opportunities to study and create music.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**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 2222 - Hearing the Movies: Evolution & Emotion of Film Music**

This course surveys the development of film music. Students will learn how music functions to support the aesthetic/narrative elements of the story. Students will learn skills to identify how music manipulates the listener and how composers shape that manipulation.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Summer

**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

**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:** On Demand

**FA 2400 - Huskies Pep Band**

The Huskies Pep Band provides enthusiastic support for a number of athletic programs at MTU and participates in important events in the community. The HPB is one of the most visible programs in the University. We are known as one of the country's most spirited college pep bands anywhere. May be used once as a general education co-curricular course.

**Credits:** 1.0; May be repeated; Graded Pass/Fail Only

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

**Semesters Offered:** Fall, Spring

**FA 2402 - Campus Concert Band**

The Concert Band provides the opportunity for students to pursue an interest in instrumental performance through the medium of a concert wind band. Repertoire of the ensemble includes music of the highest calibre 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:** 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 2500 - 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 2501 - Basic Musicianship: Skill Acquisition in Music Reading, Sight-Singing, and Ear-Training**

Skill acquisition in music reading, sight-singing, ear-training, conducting and formal analysis. Introduction to melodic and rhythmic performance systems. An aural reinforcement of concepts taught in FA2500.

**Credits:** 2.0

**Lec-Rec-Lab:** (0-1-2)

**Semesters Offered:** Fall

**Pre-Requisite(s):** FA 2500(C)

**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 2580 - Group Voice**

The fundamentals of speech and singing including information about the vocal instrument, the vocal process, vocal technique, and how to learn and perform simple solo songs.

**Credits:** 2.0

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

**Semesters Offered:** Spring

**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, Spring, Summer

**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

**Pre-Requisite(s):** FA 2600

**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

**Pre-Requisite(s):** FA 2600

**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 Visual and Performing 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; May not be enrolled in one of the following Major(s): Theatre & Electr. Media Perf.

**FA 2661 - Mainstage Theatre: Crew**

Open to students selected for the crew of a mainstage theatre production sponsored by the Department of Visual and Performing Arts. Positions on stage crews are open to all MTU students. Work assignments will be made by the technical director of the Department of Visual and Performing Arts.

**Credits:** variable to 3.0; May be repeated

**Semesters Offered:** Fall, Spring

**FA 2662 - Mainstage: Sound Crew**

Students gain hands-on experience working on the crew for live recording sound production as well as the maintenance and organization to support production.

**Credits:** variable to 3.0; May be repeated

**Semesters Offered:** Fall, Spring

**Pre-Requisite(s):** FA 1662 and FA 1664 and FA 1702

**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 KCACTF, AES, USITT, and URTA.

**Credits:** 1.0; Repeatable to a Max of 6

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

**Semesters Offered:** Fall, Spring

**Restrictions:** Permission of instructor required

**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 performers, directors, designers, and technicians.

**Credits:** 3.0

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

**Semesters Offered:** On Demand

**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, Spring - 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**

Advanced performance course wherein students experience professional working process of film, video, or stage production. Students must audition for and be cast in a leading role in an approved production. See FA2660 for non-majors.

**Credits:** 1.0

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

**Semesters Offered:** Fall, Spring

**Restrictions:** Permission of instructor required; Must be enrolled in one of the following Major(s): Theatre & Electr. Media Perf.

**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 3112 - Music Composition I: Techniques of Contemporary Composition**

This course is a study in the art of acoustic instrumental, vocal and MIDI composition. Students will study music of contemporary composers and create compositions for performance.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** FA 2500 and FA 3530

**FA 3122 - Music Composition II: Composition and Media**

This course is a continuation of Composition I. Students expand their skills to include composition for media including, film, television, and digital arts. Students will apply their skills to create fully realized live performances of their compositions.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** FA 2500 and FA 3530 and FA 3112

**FA 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:** 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, Summer

**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 wood, 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:** On Demand

**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 3360 - Ceramic Sculpture**

Explores the material properties and expressive potential of clay. Learning a variety of sculptured techniques, students will demonstrate the ability to incorporate the elements and principles of art (line, space, form, harmony) to create aesthetic artwork.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-2-3)

**Semesters Offered:** Fall

**Pre-Requisite(s):** FA 2305 or FA 3305

**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 3501 - Advanced Musicianship: Score Reading, Conducting Technique, Ear-Training, and Musicianship**

Continuation of Basic Musicianship (FA2501). In-depth analysis of music scores; intermediate conducting technique; comparison of music recordings; principles of musicianship; music performance.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** FA 2501

**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 3520 - Music Perception: Why Does Music Work?**

This course explores the human perception of music and sound from the perspectives of psychology, physiology, and aesthetics. Topics include: musical analysis, evaluation of music, and historical contexts.

**Credits:** 3.0

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

**Semesters Offered:** Spring, Summer - Offered alternate years beginning with the 2010-2011 academic year

**Restrictions:** May not be enrolled in one of the following Class(es): Freshman  
**Pre-Requisite(s):** FA 2500

**FA 3530 - Music Theory II**

Study of fundamentals of tonal harmony, including expanded harmonies. Study of complex rhythms. Introduction to formal and harmonic analysis. Ear training and sight-reading. Utilizes synthesizers, computers, and music software.

**Credits:** 3.0

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

**Semesters Offered:** Spring, Summer

**Pre-Requisite(s):** FA 2500 and (UN 1002 or UN 1003)

**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 3570 - The History of Country and Western Music**

This interactive course traces the evolution of American country music from its origins to the present. Explores biographies and music of prominent composers and performers, and gives students the opportunity to perform popular songs or compose their own.

**Credits:** 3.0

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

**Semesters Offered:** On Demand

**FA 3625 - History of Rock**

This course will acquaint the student with the musical, historical, cultural, and sociological elements of Rock Music. It covers the major stylistic eras from 1948 - present, the "pre-rock" era and the major artists and their contributions. Emphasis is placed on students developing interactive, aural and critical skills.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Summer

**FA 3650 - Stage Management**

Procedures and skills for effective stage management of theatrical productions, including coordination of performers and technicians during rehearsal and performance periods. Instruction in stage manager's notation used for blocking, scene shifts, and cues for lighting, sound, special effects, and performers.

**Credits:** 3.0

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

**Semesters Offered:** Spring - Offered alternate years beginning with the 2009-2010 academic year

**Restrictions:** May not be enrolled in one of the following Class(es): Freshman  
**Pre-Requisite(s):** FA 1701 and FA 1702

**FA 3661 - Mainstage Theatre: Management and Design**

Open to students who take significant responsibility for a Visual and Performing Arts production, such as stage manager, assistant designer, or assistant director.

**Credits:** variable to 3.0; May be repeated

**Semesters Offered:** Fall, Spring

**Pre-Requisite(s):** FA 2661

**FA 3662 - Mainstage: Sound Design**

Open to students who take significant responsibility for sound on a major production, such as sound designer, recording engineer, live sound engineer.

**Credits:** variable to 3.0; May be repeated

**Semesters Offered:** Fall, Spring

**Restrictions:** Permission of instructor required

**Pre-Requisite(s):** FA 1662 and FA 1664 and FA 1702 and FA 2662 and FA 3730

**FA 3663 - Professional Presentation**

Provides students the opportunity to present at professional events which contribute to the development of their careers. Students will prepare and present design, technical, or performance projects, papers, and/or posters to be viewed and critiqued by professionals at such events as KCACTF, AES, USITT, and URTA.

**Credits:** 1.0; Repeatable to a Max of 4

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

**Semesters Offered:** Fall, Spring

**Restrictions:** Permission of instructor required

**Pre-Requisite(s):** FA 3700 or FA 3730 or FA 3750 or FA 3760

**FA 3675 - Personal Finance for Performers**

Provides a foundation for managing personal finances to meet the challenges of establishing a professional performance career.

**Credits:** 1.0

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

**Semesters Offered:** On Demand

**FA 3680 - Period Acting Styles**

Provides knowledge and experience in playing the manners, movement, and language in plays of the most frequently performed periods.

**Credits:** 3.0

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

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

**Pre-Requisite(s):** FA 2600 and FA 2610

**FA 3700 - Scenic Design**

Fundamentals of designing theatrical scenery through various explorations and projects. Focus on professional design development and presentation techniques: theatrical drafting conventions, renderings, scale models. Also, designer/director relationships, script analysis, research design concepts/history/styles. Students are introduced to a mainstage theatre design.

**Credits:** 3.0

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

**Semesters Offered:** Spring - Offered alternate years beginning with the 2000-2001 academic year

**Restrictions:** May not be enrolled in one of the following Class(es): Freshman  
**Pre-Requisite(s):** FA 1701



**FA 3701 - Advanced Backstage Technology**

Techniques, theories, and terminology of technical theatre. Focus on practical application of advanced stagecraft through safety, woodworking, metalworking, budgeting, project management, and shop management.

**Credits:** 3.0

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

**Semesters Offered:** Fall - Offered alternate years beginning with the 2011-2012 academic year

**Pre-Requisite(s):** FA 1701

**FA 3710 - Vocal Approaches for Theatre and Electronic Media**

Students will learn vocal approaches to specific types of speaking situations, including radio commercials, instructional videos, announcing, cartoons, and theatrical productions. Students will practice vocal projection for a large theatre/auditorium, as well as microphone technique for electronic media.

**Credits:** 3.0

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

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

**Pre-Requisite(s):** FA 2830(C)

**FA 3730 - Sound Design**

Introduction to designing sound through design projects. Focuses on fundamental technical understanding, practical design presentation techniques, specific drafting conventions, exploration of sound equipment, designer/ director/artist relationships, script analysis and design concepts, and design history.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Summer

**Pre-Requisite(s):** FA 1662 and FA 1664 and FA 1702

**FA 3731 - Audio Creative Lab I**

A creative lab for students interested in the aural arts. Students will be challenged to create sound designs and compositions in response to various aesthetic, dramatic, and philosophical goals for radio, multimedia, and live performance.

**Credits:** 1.0

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

**Semesters Offered:** Fall

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

**Pre-Requisite(s):** FA 1662 and FA 1664 and FA 1702 and FA 2662 and FA 3730

**FA 3732 - Audio Creative Lab II**

A creative lab for students interested in the aural arts. Students will be challenged to create sound designs and compositions in response to various aesthetic, dramatic, and philosophical goals for radio, multimedia, and live performance. Note: FA3731 and FA3732 cover different projects and can be taken independently of one another.

**Credits:** 1.0; Repeatable to a Max of 4

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

**Semesters Offered:** Fall, Spring

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

**Pre-Requisite(s):** FA 1662 and FA 1664 and FA 1702 and FA 3730

**FA 3735 - Music, Film, and Theatre Sound**

Explores the ambient acoustic environment of everyday life and popular culture, including how sound is used to manipulate emotions and thoughts. Students will learn to analyze sound and develop competence in creating artistically motivated sounds.

**Credits:** 3.0

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

**Semesters Offered:** Summer

**Restrictions:** May not be enrolled in one of the following Major(s): Sound Design, Audio Production & Technology

**Pre-Requisite(s):** UN 1002 or UN 1003

**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, Summer

**Restrictions:** Permission of instructor required

**Pre-Requisite(s):** FA 1662 and FA 1664 and FA 1702

**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

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

**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/fabric analysis. Also, designer/director relationships, script/character analyses, research, design concepts. Students are introduced to a mainstage theatre design.

**Credits:** 3.0

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

**Semesters Offered:** Fall - Offered alternate years beginning with the 2003-2004 academic year

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

**FA 3780 - Directing for Theatre**

A comprehensive, in-depth study of mounting a theatre production with an emphasis on directing. Through script analysis, students study the necessary production elements, how they interrelate, and directing techniques to create a unified production from the director's vision.

**Credits:** 3.0

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

**Semesters Offered:** On Demand

**Restrictions:** Permission of instructor required

**Pre-Requisite(s):** FA 2800 and (UN 1002 or UN 1003)

**FA 3810 - Ancient Theatre History**

An in-depth examination of theatre 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

**Pre-Requisite(s):** UN 1002 or UN 1003

**FA 3821 - Modern Theatre History**

Examination of American and European theatre history from the 1700s to modern times. An emphasis on the interrelationships among technology and theatre space, design and drama, and how culture and society affected style.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** 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:** On Demand

**Pre-Requisite(s):** UN 1002 or UN 1003

**FA 3860 - Costume History**

A study of costume fashion, emphasis on the western world, from antiquity through the 20th Century. Including: basic characteristics of each period, environmental & cultural influences, specific costume terminology. Comparative analysis of historic costume choices found in film & theatre.

**Credits:** 3.0

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

**Semesters Offered:** Fall - Offered alternate years beginning with the 2011-2012 academic year

**FA 3880 - Readings in Dramatic Literature**

An examination of dramatic literature with an emphasis on theatre production. Students will examine a selection of plays each semester. Students can repeat the course up to four times; each semester examines different plays.

**Credits:** 1.0; Repeatable to a Max of 4

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

**Semesters Offered:** Fall, Spring, Summer

**Restrictions:** Must be enrolled in one of the following Major(s): Theatre & Entertain Tech (BA), Theatre & Entertain Tech (BS), Sound Design, Theatre & Electr. Media Perf., Audio Production & Technology; May not be enrolled in one of the following Class(es): Freshman

**FA 3975 - Portfolio Development**

Techniques for building and presenting an electronic and hardcopy design and technical professional portfolio for the theatre and entertainment industry. The final result of the course will be a portfolio of all work to date.

**Credits:** 1.0

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

**Semesters Offered:** Fall

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



**FA 4010 - Film/Video/Stage Practicum IV**

Students must audition and be cast in a leading role in an approved film, video, or stage production. Documentation of character development and performance experience is required. Leadership in vocal and physical warm-ups is expected.

**Credits:** 1.0

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

**Semesters Offered:** Fall, Spring

**Restrictions:** Permission of instructor required; Must be enrolled in one of the following Major(s): Theatre & Electr. Media Perf.

**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, 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 4701 - Stage Mechanics and Rigging**

Practical application and theory of stage mechanics and rigging. Emphasis will be placed on theatrical systems such as line-sets, turntables, and scenery lifts. Course will also explore automation through pneumatics, hydraulics, and motor control.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring - Offered alternate years beginning with the 2010-2011 academic year

**Pre-Requisite(s):** FA 1701 and FA 3701

**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:** On Demand

**Restrictions:** Must be enrolled in one of the following Major(s): Sound Design, Audio Production & Technology

**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:** (0-3-0)

**Semesters Offered:** Spring

**Restrictions:** Must be enrolled in one of the following Major(s): Theatre & Entertain Tech (BS), Sound Design, Audio Production & Technology

**Co-Requisite(s):** FA 4741

**Pre-Requisite(s):** FA 1702 and FA 2662 and FA 3730 and PH 1090

**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:** Spring

**Restrictions:** Must be enrolled in one of the following Major(s): Theatre & Entertain Tech (BS), Sound Design, Audio Production & Technology

**Co-Requisite(s):** FA 4740

**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

**FA 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

**FA 4950 - Special Topics in Visual & Performing 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:** On Demand

**Restrictions:** Permission of instructor required

**FA 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

**FA 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

**FA 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

**FA 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

**FA 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, Summer

**Restrictions:** Permission of instructor required

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## Finance

**FIN 3000 - Principles of Finance**

Introduction to the principles of finance. Topics include financial mathematics, the capital investment decision, financial assets valuation, and the risk-return relationship

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring, Summer

**Pre-Requisite(s):** (MA 2710 or MA 2720 or MA 3710 or BUS 2100 or BA 2100) and (ACC 2100(C) or BA 2310 or BA 2340)

**FIN 4000 - Investment Analysis**

Overview of financial products. Operations of the stock market, bond market, and other financial markets. Focus on portfolio theory and basic stock and bond valuation techniques.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** BA 3400 or EC 3400 or FIN 3000

**FIN 4100 - Advanced Financial Management**

Advanced topics in managerial finance: Advanced capital budgeting, project analysis, capital acquisition, capital structure and dividend policy, and other topics.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** BA 3400 or EC 3400 or FIN 3000

**FIN 4200 - Derivatives and Financial Engineering**

Covers the pricing and use of options, financial futures, swaps, and other derivative securities.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** BA 3400 or EC 3400 or FIN 3000

**FIN 4300 - Personal Financial Planning**

Overview of personal financial issues and services and instruments offered by economic and financial institutions. Topics include the personal financial environment, 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 or FIN 3000

**FIN 4400 - Security Analysis**

Detailed analysis of security valuation. Topics include fundamental analysis (financial statement analysis, free cash flow valuation, credit analysis, ratio analysis), technical analysis, and quantitative analysis.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring

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

**Pre-Requisite(s):** FIN 3000 or BA 3400 or EC 3400

**FIN 4500 - Financial Risk Management and Financial Engineering**

Detailed analysis of the measurement of financial risk and the tools and techniques available to manage financial risk. Topics include financial disasters, risk measurement (market, default, currency exchange, value-at-risk) and the hedging of these risks.

**Credits:** 3.0

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

**Semesters Offered:** Fall

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

**Pre-Requisite(s):** FIN 3000 or BA 3400 or EC 3400

**FIN 4700 - Global Finance**

Studies international financial systems and markets. Covers the principle of comparative advantage, balance of payments, exchange rate systems, theories of international finance, identification of international risk exposures, the management and treatment of risk, and special topics of international finance.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** BA 3400 or EC 3400 or FIN 3000

**FIN 4801 - Applied Portfolio Management I**

Covers issues in the management and administration of investments in an institutional setting. Students form a new investment firm and manage a real portfolio of financial assets.

**Credits:** variable to 3.0

**Semesters Offered:** Summer

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

**FIN 4802 - Applied Portfolio Management II**

Covers issues in the management and administration of investments in an institutional setting. Students form a new investment firm and manage a real portfolio of financial assets.

**Credits:** variable to 3.0

**Semesters Offered:** Fall

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

**FIN 4803 - Applied Portfolio Management III**

Covers issues in the management and administration of investments in an institutional setting. Students form a new investment firm and manage a real portfolio of financial assets.

**Credits:** variable to 3.0

**Semesters Offered:** Spring

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

**FIN 4900 - 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 or FIN 3000

**Forest Resources & Environmental Science****FW 1035 - Wood Anatomy and Properties**

An introduction to the micro- and macro-anatomy of wood, how wood structure is related to its function in the tree, wood quality, physical properties, and its utilization as an industrial raw material.

**Credits:** 4.0

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

**Semesters Offered:** Spring

**FW 1050 - 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, and community ecology, with an emphasis on trees. Systematic study of the major forested vegetation types of North America.

**Credits:** 4.0

**Lec-Rec-Lab:** (2-1-3)

**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:** 2.0

**Lec-Rec-Lab:** (1-0-2)

**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**

Environmental factors and plant and animal characteristics which control composition, structure, and function of forest ecosystems. Emphasis on how ecosystems change across space and time and knowledge needed to sustainably manage forest ecosystems for social, economic, and ecological benefits.

**Credits:** 3.0

**Lec-Rec-Lab:** (2-0-3)

**Semesters Offered:** Fall

**Pre-Requisite(s):** FW 2010(C) and FW 2051(C)

**FW 3075 - Introduction to Biotechnology**

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-pharmaceuticals. 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:** Must be enrolled in one of the following Major(s): Forestry,

Wildlife Ecology & Mgmt, App Ecol & Environ Sci

**Pre-Requisite(s):** FW 2051 and FW 3020 and FW 3200 and (MA 2710 or MA

2720 or MA 3710)

**FW 3200 - 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 3313 - Sustainability Science, Policy, and Assessment**

Foundational scientific concepts (dynamic systems and catastrophe theory) as applied to socioecological systems. Use of indicators and indices to track progress towards sustainability goals. Review of local, national, and global sustainability policies to avoid catastrophes and guide sustainable development.

**Credits:** 3.0

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

**Semesters Offered:** On Demand - Offered alternate years beginning with the 2010-2011 academic year

**Pre-Requisite(s):** UN 2002

**FW 3320 - Fundamentals of Forest Genetics and Genomics**

This course will teach fundamental and applied genetic principles that are essential for management of forest and other ecosystems to maintain their long-term health and sustainability. The class will cover the following topics: structure and function of DNA, inheritance, molecular evolution, population and quantitative genetics, gene conservation, genomics and biotechnology.

**Credits:** 3.0

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

**Semesters Offered:** Spring

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

**FW 3330 - Soil Science**

Introduction to the chemical, physical, and biological properties of soil.

**Credits:** 4.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** CH 1112(C) or (CH 1150(C) and CH 1151(C))

**FW 3376 - Forest & Environmental Resource Management (The FERM) I**

Application of forest and environmental management practices by teams of students with the assistance of faculty, staff and representatives of state, federal and corporate land management groups as well as non-governmental organizations.

**Credits:** 2.0; May be repeated

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

**Semesters Offered:** Fall, Spring, Summer

**Pre-Requisite(s):** FW 2010 and FW 2051

**FW 3377 - Forest & Environmental Resource Management (The FERM) II**

Application of forest and environmental management practices by teams of students with the assistance of faculty, staff, and representatives of state, federal, and corporate land management groups as well as non-governmental organizations.

**Credits:** 3.0; May be repeated

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

**Semesters Offered:** Fall, Spring, Summer

**Pre-Requisite(s):** FW 2010 and FW 2051

**FW 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 ARCGIS software package.

**Credits:** 4.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** MA 2710(C) or MA 2720(C) or MA 3710(C)

**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 3621 - Field Ornithology Techniques**

We explore the biology, behavior, and field ecology of birds. Students will learn to identify the common birds of the Upper Peninsula by sight and sound. The course involves a trip to Seney National Wildlife Refuge and Whitefish Point Bird Observatory.

**Credits:** 3.0

**Lec-Rec-Lab:** (2-0-1)

**Semesters Offered:** Summer

**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

**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:** Fall - Offered alternate years beginning with the 2011-2012 academic year

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

**FW 4099 - Programming Skills for Bioinformatics**

Students will learn computer programming skills in Perl for processing genomic sequences and gene expression data and become familiar with various bioinformatics resources. The students will use real sequence and expression data and develop computer programs to solve real problems.

**Credits:** 3.0

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

**Semesters Offered:** Fall - Offered alternate years beginning with the 2011-2012 academic year

**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**

A study of tree structure, growth, development and function, and how these are related to the environment. We will focus on the cycling of water, carbon, and nutrients within the context of global change.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**FW 4128 - Conservation Genetics**

This course explores how genetic variation and its loss affect the ability of natural populations to adapt to changing environments. The relevance for the long-term conservation of animal and plant populations is highlighted.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**FW 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 4220 - 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 - Mammalogy**

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. Not open to students with credit in FW4250.

**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 4250 - The Wolves and Moose of Isle Royale**

Wolves and moose have been studied for 50 years on Isle Royale, a wilderness island in Lake Superior. The instructor leads this research and uses the research to explain predation, population dynamics, conservation genetics, and other ecological principles. Not open to students with credit in FW4240.

**Credits:** 2.0

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

**Semesters Offered:** Fall

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

**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

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

**Pre-Requisite(s):** FW 3020 and (FW 3010 or FW 3012)

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

**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 2012-2013 academic year

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



**FW 4541 - Remote Sensing of the Environment Lab**

Offers students hands-on experience applying remote sensing principles and concepts to real world issues in resource management and ecosystem science. Various types of imagery and other remotely sensed data are presented along with relevant theory and analysis methods.

**Credits:** 1.0

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

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

**Co-Requisite(s):** FW 4540

**FW 4545 - Map Design with GIS**

Principles of making maps, from traditional to advanced visualization techniques, that convey information which is useful in decision making at many levels. Focus will be on creating maps using GIS software and digital data. A working knowledge of ArcMap is required.

**Credits:** 2.0

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

**Semesters Offered:** Spring - Offered alternate years beginning with the 2011-2012 academic year

**Restrictions:** Must be enrolled in one of the following Class(es): Freshman, Sophomore

**Pre-Requisite(s):** FW 3540 or FW 5550

**FW 4610 - Wildlife Ecology**

Covers the ecological basis for management of wildlife, including biological and sociological factors that influence management.

**Credits:** 3.0

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

**Semesters Offered:** Fall

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

**Pre-Requisite(s):** BL 3400(C) or FW 3020(C)

**FW 4620 - Herpetology**

The biology of amphibians and reptiles, including evolution, zoogeography, ecology, behavior and physiology.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** BL 1040 or BL 1020

**FW 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 forestry, applied ecology, wildlife ecology, and management core courses. Covers multi-resource inventory of forested landscapes evaluation of forest parameters and the development of management plans for various natural resource alternatives.

**Credits:** 4.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** FW 3190

**FW 4840 - Senior Research Thesis**

An independent study or research project on an approved topic in Forestry, Applied Ecology and Environmental Sciences, or Wildlife Ecology and Management, developed under the guidance of a faculty member. Available only to students in their graduating year.

**Credits:** 4.0

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

**Semesters Offered:** Fall, Spring

**Restrictions:** Permission of instructor required; Must be enrolled in one of the following Class(es): Senior

**Pre-Requisite(s):** FW 3190

**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 4900 - Applied Experiment Design and Data Analysis**

This course is offered to enhance the student's knowledge in designing experiments, and the skills in analyzing and interpretation of experimental data resulting from field trials of forestry. The course will use programming language R, an open source tool that can be installed and run in any platforms.

**Credits:** 3.0

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

**Semesters Offered:** Spring - Offered alternate years beginning with the 2011-2012 academic year

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

**Pre-Requisite(s):** MA 2720(C) or MA 2710(C)

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## Geological & Mining Engineering & Sciences

**GE 1100 - Geological Engineering and Sciences Orientation**

Introduction to geosciences as a profession, including discussions of career opportunities and geoscience programs. Earth materials and the earth's processes are also introduced. Includes frequent field trips. Intended for freshman or sophomore students in geological engineering, geology, applied geophysics, hydrology, geotechnics, earth science teaching, or any other geoscience program.

**Credits:** 1.0; Graded Pass/Fail Only

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

**Semesters Offered:** Fall

**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, Spring, Summer

**GE 2020 - Introduction to Mining Engineering and Mining Methods**

Learn how various mining components, from prospecting to financing to reclamation, fit together. Includes advantages and drawbacks of different mining methods and their selection. Introduces ethics and professional development. Use of basic computer and mine design software.

**Credits:** 4.0

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

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

**GE 2100 - Environmental Geology**

Introduction and study of current environmental issues related to the earth sciences. Covers major topics such as volcanism, earthquakes, shoreline erosion, and pollution of groundwater as multi-week modules with associated labs, lectures, and field projects.

**Credits:** 3.0

**Lec-Rec-Lab:** (2-0-3)

**Semesters Offered:** Spring

**GE 2300 - Introduction to 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 1150 and CH 1151)

**GE 2310 - Introduction to Petrology**

Identification, physical properties, chemical composition, occurrence, and origin of the important types of igneous, sedimentary, and metamorphic rocks. Laboratory includes hand specimen description and identification of rocks.

**Credits:** 3.0

**Lec-Rec-Lab:** (2-0-3)

**Semesters Offered:** Spring

**Pre-Requisite(s):** GE 2300



**GE 2500 - Introduction to Oceanography**

Effect of waves, tides, currents, natural hazards along shorelines, and air-sea interactions on the climate.

**Credits:** 3.0

**Lec-Rec-Lab:** (2-0-3)

**Semesters Offered:** Spring

**GE 2640 - Atmospheric Observations and Meteorology**

Introduction to fundamentals of atmospheric science and meteorology through direct observations of the atmosphere.

**Credits:** 3.0

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

**Semesters Offered:** Fall - Offered alternate years beginning with the 2002-2003 academic year

**GE 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**

Rock structures and regional settings resulting from the application of deforming forces, including the geometry, origin, and mechanics of folds, foliations, lineations, faults and 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 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 geological datasets.

**Credits:** 3.0

**Lec-Rec-Lab:** (2-0-1)

**Semesters Offered:** Spring

**Restrictions:** May not be enrolled in one of the following Class(es): Freshman  
**Pre-Requisite(s):** MA 1160 or MA 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 3710 - Geology and Ecology of Modern Reefs**

Introductory lab/field course intended for students interested in learning about the geology and ecology of the modern reefs of the Kenya Coast. The course will focus on the geology of the near-shore environment.

**Credits:** 2.0

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

**Semesters Offered:** Spring

**Restrictions:** Permission of department required

**GE 3720 - Soil Genesis and Crops**

The quality of many high-value crops depends on climate and soil conditions. Geology, topography, and ocean proximity combine to produce distinct microclimates and soils which impact crop attributes. We will explore relationships between these factors and crops in the Cape Town region.

**Credits:** 2.0

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

**Semesters Offered:** Spring, 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 4100 - Geomorphology and Glacial Geology**

The study of the processes, including fluvial, glacial, wind, mass movement, and wave action, shaping the earth's surface by erosion and deposition of geologic materials. Emphasizes the role of past and present climate. Field trips are a major component.

**Credits:** 4.0

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

**Semesters Offered:** Fall - Offered alternate years beginning with the 2003-2004 academic year

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

**Pre-Requisite(s):** GE 2000

**GE 4150 - Natural Hazards**

This course focuses on current mitigation agencies and warning systems, case studies of successes and failures in hazard mitigation, and technical tools for hazard study and mitigation such as satellite remote sensing and GIS.

**Credits:** 3.0

**Lec-Rec-Lab:** (2-0-3)

**Semesters Offered:** Fall

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

**Pre-Requisite(s):** (GE 2000 or GE 2100) and UN 2002

**GE 4250 - Fundamentals of Remote Sensing**

This course focuses on the basic physics behind above- surface remote sensing and remote sensing systems. Topics covered include: properties of the atmosphere, absorption and scattering of electromagnetic radiation, instrument design, data acquisition and processing, validation, and basic applications.

**Credits:** 3.0

**Lec-Rec-Lab:** (2-1-0)

**Semesters Offered:** Spring

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

**Pre-Requisite(s):** PH 2200 and MA 2160

**GE 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 2100

**GE 4500 - Plate Tectonics and Global Geophysics**

Plate tectonics and the internal structure of the earth using information from seismology, geomagnetism, gravity, and heat flow.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring

**Pre-Requisite(s):** MA 3160 and PH 2200 and GE 2000

**GE 4504 - Air Quality Engineering and Science**

Overview of air quality regulation in the U.S. and world, including basic concepts of atmospheric chemistry and transport; fugitive, point, and air emissions; principles and tradeoffs of operation and design of air pollution control systems; and application of air quality models.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** ENVE 3501 or ENVE 3503

**GE 4530 - Planetary Geology & Geophysics**

Geological, geophysical, and geochemical processes in the Solar System are examined. Topics include the formation and evolution of the Solar System, planetary surface processes and water distribution, impact structures, composition, structure, and dynamics of planetary interiors, geophysical exploration of planets.

**Credits:** 3.0

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

**Semesters Offered:** Fall

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

**Pre-Requisite(s):** GE 2000 and PH 2200 and MA 2160

**GE 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 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 4860 - Computer Methods in Geomechanics**

Computer methods for the design problems encountered in geomechanics. Applications to be selected from slope stability, earth retention systems, and seepage. Students will be introduced to limit equilibrium and finite element analysis through theory and computational labs.

**Credits:** 3.0

**Lec-Rec-Lab:** (2-0-3)

**Semesters Offered:** Fall

**Pre-Requisite(s):** CE 3810

**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 and South Africa**

Introduction to methods and problems of field geology. Data gathering and interpretation of field relationships using Brunton, GPS LandSat, etc. in East Africa. Requires geological report and digital maps.

**Credits:** 6.0

**Lec-Rec-Lab:** (0-0-18)

**Semesters Offered:** Spring

**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 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

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**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 Composition. (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

**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

**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, Summer

**Co-Requisite(s):** UN 1002

**HU 0123 - Composition Coaching**

Scheduled weekly appointment with a writing coach to improve writing and reading effectiveness in Composition (UN2001). Strongly recommended for students with English ACT of 20 or below. Credits do not count toward graduation.

**Credits:** 0.0; May be repeated

**Semesters Offered:** Fall, Spring, Summer

**Co-Requisite(s):** UN 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

**Semesters Offered:** Fall, Spring, Summer

**Restrictions:** Must be enrolled in one of the following Level(s): Graduate

**HU 0125 - Int'l GTA Assistance Program**

International graduate students can enroll in HU0125 to work on cultural differences in presentation skills and to practice speaking instructional English. These students will meet weekly in group and individual settings to improve their facility as speakers of English. Credits do not count toward graduation.

**Credits:** 0.0; May be repeated

**Semesters Offered:** Fall, Spring

**Restrictions:** Must be enrolled in one of the following Level(s): Graduate

**HU 2110 - The Writer's Craft**

An introduction to reading and writing in contemporary and emerging creative writing, including, but not limited to, fiction, nonfiction, poetry, and screenplay. Stresses individual production through process-oriented writing exercises, small group workshops, individual conferences, and creative theory.

**Credits:** 3.0

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

**Semesters Offered:** Fall, 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 grammar, vocabulary, and idioms, designed to help students acquire the basics of oral and written communication. Includes study of cultures in which the language is spoken.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Summer

**Restrictions:** May not be enrolled in one of the following Class(es): Senior

**HU 2242 - Level I-B Less Commonly Taught Languages**

Further study of grammar, vocabulary, and idioms with emphasis on conversation and communicative strategies. Includes continued study of cultures in which the language is spoken.

**Credits:** 3.0

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

**Semesters Offered:** On Demand

**Pre-Requisite(s):** HU 2241

**HU 2271 - Level I-A French Language and Culture**

Introduction to basic French grammar, vocabulary, and idioms designed to help students acquire the basics of oral and written French. Includes study of contemporary French-speaking cultures.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring, Summer

**Restrictions:** May not be enrolled in one of the following Class(es): Senior

**HU 2272 - Level I-B French Language and Culture**

Further study of French grammar, vocabulary, and idioms with continued practice of conversation and basic readings in French. Continued study of contemporary French speaking cultures.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring, Summer

**Pre-Requisite(s):** HU 2271 or Language Placement French I >= 101

**HU 2273 - Transitional Level I French Language and Culture**

Intensive study of basic French grammar, vocabulary, and culture. Designed to prepare students with minimum essentials of oral and written French for intermediate and advanced level work. Students completing this course may apply for placement credits.

**Credits:** 3.0

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

**Semesters Offered:** On Demand

**Pre-Requisite(s):** Language Placement French I >= 101

**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

**Pre-Requisite(s):** HU 2281 or Language Placement German I >= 201

**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

**Pre-Requisite(s):** HU 2291 or Language Placement Spanish I >= 201

**HU 2324 - Introduction to Film**

Focuses on film narration and style within social, cultural, and historical contexts. Emphasizes critical engagement with film through discussion, presentations, and written analysis. May include small video production projects and opportunities to interact with filmmakers and industry professionals.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-2-3)

**Semesters Offered:** Fall, Spring, 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 - American Experience in Literature**

A survey of major works in American Literature from origins to the present. Focuses on historical trends in the development of literature and culture in the Americas with particular emphasis on the United States.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**HU 2505 - Science, Technology, and Humanities**

A survey using literary texts, narrative history, documentary evidence, film, music, and cross-cultural references to contextualize the emergence of scientific, technological, and humanistic developments in the modern era.

**Credits:** 3.0

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

**Semesters Offered:** On Demand - Offered alternate years beginning with the 2000-2001 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 across the Americas, films, and essays on theories and approaches to difference in the American context.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**HU 2538 - British Experience in Literature**

A survey of selected works of British literature from its origins to the present. Focuses on historical trends in the development of the English language and the cultures of Great Britain.

**Credits:** 3.0

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

**Semesters Offered:** Fall - Offered alternate years beginning with the 2002-2003 academic year

**HU 2540 - The Spoken Word**

Study of spoken and/or performed literatures, staged and paged, including, but not limited to oral tradition, poetry, spoken work, hip-hop, rap, screenplay, and drama.

**Credits:** 3.0

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

**Semesters Offered:** Spring - Offered alternate years beginning with the 2011-2012 academic year

**HU 2548 - Young Adult Literature**

Reading, reflecting on, and responding to age-appropriate adolescent literature. Works include authors from different races, cultures, historical periods, and genders. Discussion may be supplemented with films.

Appropriate for students who plan to be parents, community volunteers, and teachers.

**Credits:** 3.0

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

**Semesters Offered:** Fall, 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 2633 - Fundamentals of Digital Imaging**

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, Spring, 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, 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 2810 - Research and Writing in Communication**

Prepare students to evaluate, design, and conduct research in communication. Develops research-related writing strategies and proficiency.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** UN 1001 and UN 2001(C)

**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 3110 - The Writer's Workshop**

Workshop practice in creative writing. May include fiction, nonfiction, poetry, screenplay, or hybrid forms. Stresses individual production through process-oriented writing exercises, small group workshops, individual conferences and creative theory with the goal of creating manuscripts of publishable quality.

**Credits:** 3.0; Repeatable to a Max of 6

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

**Semesters Offered:** Spring - Offered alternate years beginning with the 2011-2012 academic year

**Pre-Requisite(s):** HU 2110(C)

**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, Spring

**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 3241 - Level II A Less Commonly Taught Language and Culture**

Review and continued study of listening, speaking, reading, and writing in less commonly taught language. Students learn how to communicate in target culture. Includes study of various aspects of the culture in which the language is used.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** HU 2242

**HU 3242 - Level II B Less Commonly Taught Language and Culture**

Further study of less commonly taught language. Includes study of vocabulary, idioms, and sentence structure to improve conversational reading and writing abilities and discussions of various aspects of culture in which the language is used.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** HU 3241

**HU 3253 - World Literatures & Cultures**

Comparative approach to world literatures and cultures. May include literary works, critical essays, films, music, and other representations of world culture.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring

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

**Pre-Requisite(s):** UN 1002 or UN 1003

**HU 3261 - Topics in Communicating Across Cultures**

Examines communication practices and styles across selected cultures and multicultural groups, drawing on an interdisciplinary range of research fields. May address social issues, language and cultural differences, gender, race, ethnicity, class, disabilities, age, religion, family and national identity.

**Credits:** 3.0; Repeatable to a Max of 6

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

**Semesters Offered:** On Demand

**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, Spring

**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, 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:** Fall, 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:** Fall, 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:** Spring

**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:** Fall, Spring

**Pre-Requisite(s):** HU 2293 or HU 3291 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; 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 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 3400 - Topics in Diversity Studies**

This course provides students with a better understanding of underrepresented populations within the United States by examining the culture and experience of African American; American Indian; Asian American; Latina/Latino American; Gay, Lesbian, Bisexual, and Transsexual; or Post-Colonial peoples.

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

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

**Semesters Offered:** Spring

**HU 3501 - Medieval Literature & Cultures**

Study of literary texts and other representations of medieval culture from the European Middle Ages including English and other cultural traditions in translation.

**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 among various civilizations. Films may provide contextual background.

**Credits:** 3.0

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

**Semesters Offered:** Spring - Offered alternate years beginning with the 2001-2002 academic year

**Pre-Requisite(s):** UN 1002 or UN 1003

**HU 3504 - Studies in the Novel**

Examination of the novel in world literature with special attention to the historical, cultural, and personal contexts within which the author is writing. Film versions may be examined.

**Credits:** 3.0

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

**Semesters Offered:** On Demand

**Pre-Requisite(s):** UN 1002 or UN 1003

**HU 3510 - The American Novel**

Examination of the novel in American literature with special attention to the historical, cultural, and personal contexts within which the author is writing. Film versions may be examined.

**Credits:** 3.0

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

**Semesters Offered:** On Demand

**Pre-Requisite(s):** UN 1002 or UN 1003

**HU 3513 - Shakespeare**

In-depth study of a limited number of Shakespearean plays with special attention to dramatic structure, character development, theme presentation, and theatre history. Includes extensive study of Renaissance influences, possibly film versions of selected plays, and examination of current critical theories.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring

**Pre-Requisite(s):** UN 1002 or UN 1003

**HU 3517 - Literary Theory and Criticism**

A consideration of a variety of theoretical and critical approaches and methods of literary research in the study of British and American literature.

**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**

In-depth reading of the works of one or more British authors (excluding Shakespeare), including surrounding criticism. Film versions may be examined.

**Credits:** 3.0; Repeatable to a Max of 6

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** UN 1002 or UN 1003

**HU 3541 - Major American Authors**

In-depth reading of the works of one or more American authors, including surrounding criticism. Film versions may be examined.

**Credits:** 3.0; Repeatable to a Max of 6

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

**Semesters Offered:** Spring

**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 3554 - Science Fiction and Fantasy Literature**

Close study of significant works in science fiction and fantasy. Examines genre features and usage and attends to a writer's style and methods. Regularly focuses on historical fiction and fantasy using film to help establish literary context.

**Credits:** 3.0; Repeatable to a Max of 6

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

**Semesters Offered:** On Demand

**Pre-Requisite(s):** UN 1002 or UN 1003

**HU 3555 - Modern and Contemporary British Literature**

Study of British, British colonial and post-colonial literatures of the twentieth and twenty-first centuries. Explores relationships between literature and other areas of the arts and culture. May include attention to emerging and non-traditional writers and genres.

**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):** UN 1002 or UN 1003

**HU 3556 - Modern and Contemporary American Literature**

Study of American literatures of the twentieth and twenty-first centuries. Explores relationships between literature and other areas such as the arts, film architecture, history and philosophy. May include attention to emerging and non-traditional writers and genres.

**Credits:** 3.0

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

**Semesters Offered:** Fall - Offered alternate years beginning with the 2011-2012 academic year

**Pre-Requisite(s):** 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

**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:** Fall, 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 and HU 2632 or HU 2645

**HU 3642 - Multimedia**

Theoretical analysis and hands-on experience with integrative multimedia design. Critical analysis of multimedia projects and writings on multimedia. Design, prototype, and test a multimedia project.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** HU 2642 and HU 2632 or HU 2645

**HU 3650 - Introduction to Web Design**

Provides experience in planning and constructing web pages. Discusses historical, ethical, and social implications, as well as problems and limitations, of the Internet and the World Wide Web. Students develop a balance of technical, aesthetic, and theoretical knowledge.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-2-3)

**Semesters Offered:** Spring, Summer

**Pre-Requisite(s):** HU 2642 and HU 2645 or HU 2632

**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:** Fall

**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

**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, Summer

**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:** Spring

**Pre-Requisite(s):** UN 1002 or UN 1003

**HU 3882 - Media Industries**

Examines economic, political, and cultural aspects of media industries (cinema, broadcasting, sound-recording, advertising, and public relations) historically and in the digital context. Addresses communications policy.

**Credits:** 3.0

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

**Semesters Offered:** Fall

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

**Pre-Requisite(s):** UN 1001

**HU 3885 - Introduction to Game Design**

Historical, ethical, and social implications of game design. Critical understanding of tools, techniques, and processes through hands-on production, readings, discussion, and analysis of contemporary issues related to game design.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-2-3)

**Semesters Offered:** Fall, Spring - Offered alternate years beginning with the 2010-2011 academic year

**Pre-Requisite(s):** HU 2642 and HU 2645 or HU 2632

**HU 3890 - Documentary**

Considers technical, theoretical, aesthetic and ethical dimensions of documentary media through analysis and production.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-2-3)

**Semesters Offered:** Fall, 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:** Fall, 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 3961 - Theroetical Foundation of TESOL**

Introduction to key concepts and issues in teaching English to speakers of other languages. Topics covered may include nature of first-and-second acquisition, role of input and instruction in language learning, and evaluation of approaches to teaching and research.

**Credits:** 3.0

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

**Semesters Offered:** On Demand

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

**Co-Requisite(s):** HU 3605

**Pre-Requisite(s):** HU 2910

**HU 3962 - TESOL Methods and Materials**

Enhance understanding and awareness of the developmental stages and needs of English language learners in various learning contexts. Show how to adjust, modify, and manipulate instructional techniques and materials to accommodate the linguistic and cognitive needs of English learners.

**Credits:** 3.0

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

**Semesters Offered:** On Demand

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

**Pre-Requisite(s):** HU 3961

**HU 3963 - Assessment and Testing in TESOL**

This course covers basic principles and approaches in the assessment and testing of English as a second or foreign language in various instructional contexts. Topics covered may include test construction and adaptation and the application of this knowledge to evaluating tests.

**Credits:** 3.0

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

**Semesters Offered:** On Demand

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

**Co-Requisite(s):** HU 3961

**HU 3964 - Cross-Cultural Aspects of TESOL**

Course examines those places where language and culture come together to affect our interactions; concentrating on areas particularly important to language teaching, learning, and usage. Topics may include introduction to pragmatics, politeness theory, and conversational politeness strategies.

**Credits:** 3.0

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

**Semesters Offered:** On Demand

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

**HU 4050 - Special Topics**

Tutorial, seminar, workshop, or class study of special interest and importance in the humanities. Students should register by section number for the appropriate instructor and topic.

**Credits:** variable to 6.0; May be repeated

**Semesters Offered:** Fall, Spring, Summer

**Restrictions:** Permission of instructor required

**HU 4060 - Humanities Workshop**

Special workshop projects in the humanities such as tutorials, editing, Shakespeare Faire drama workshop, writer's workshop, or study-abroad tours. Approved credit varies by degree program.

**Credits:** variable to 6.0; May be repeated

**Semesters Offered:** Fall, Spring, Summer

**Restrictions:** Permission of instructor required

**HU 4071 - Senior Seminar in English and Liberal Arts**

A capstone seminar in which students develop, deepen and present individual research and/or creative projects which demonstrate the skills and knowledge they have acquired in the English and/or Liberal Arts major programs.

**Credits:** 3.0

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

**Semesters Offered:** 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 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**

Language and power. Critical study of the representation of politics, economics, and social institutions in literature, film, and authentic documents from French, German, and Hispanic language communities. Students read texts in French and English translations. Course offered third year beginning 2009-2010.

**Credits:** 3.0

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

**Semesters Offered:** On Demand

**Pre-Requisite(s):** HU 3274 or HU 3275

**HU 4272 - Modern Language Seminar II-French**

Individual and society. Critical study of the relationship between the individual and social institutions in literature, film, and authentic documents from French, German, and Hispanic language communities. Students read texts in French and in English translation. Course offered third year beginning 2010-2011.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring - Offered alternate years beginning with the 2001-2002 academic year

**Pre-Requisite(s):** HU 3274 or HU 3275

**HU 4273 - Modern Language Seminar III-French**

Technology in literature and film. Critical study of the representation of modern technology in literature, film, and authentic documents from French, German and Hispanic language communities. Students read texts in French and in English translation. Course offered every third year beginning 2008-2009.

**Credits:** 3.0

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

**Semesters Offered:** On Demand

**Pre-Requisite(s):** HU 3274 or HU 3275

**HU 4281 - Modern Language Seminar I-German**

Language and power. Critical study of the representation of politics, economics, and social institutions in literature, film, and authentic documents from French, German, and Hispanic language communities. Students read texts in German and in English translation. Course offered every third year beginning 2008-2009.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring

**Pre-Requisite(s):** HU 3284 or HU 3285

**HU 4282 - Modern Language Seminar II-German**

Individual and society. Critical study of the relationship between the individual and social institutions in literature, film, and authentic documents from French, German, and Hispanic language communities. Students read texts in German and in English translation. Course offered every third year beginning 2009-2010.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring - Offered alternate years beginning with the 2001-2002 academic year

**Pre-Requisite(s):** HU 3284 or HU 3285

**HU 4283 - Modern Language Seminar III-German**

Technology in literature and film. Critical study of the 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 2010-2011.

**Credits:** 3.0

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

**Semesters Offered:** Fall, 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, economics, and social institutions in literature, film, and authentic texts in French, German, and Hispanic language communities. Students read texts in Spanish and English translation.

**Credits:** 3.0

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

**Semesters Offered:** On Demand

**Pre-Requisite(s):** (HU 3294 or HU 3295) and UN 2002

**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 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 4626 - International Technical Communication**

Focuses on international workplace communication. Introduces theories of globalization. Topics may include localization, contrastive rhetoric, technical translation, and international usability.

**Credits:** 3.0

**Lec-Rec-Lab:** (2-1-0)

**Semesters Offered:** Spring

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

**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 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

**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:** Spring

**Pre-Requisite(s):** UN 1002 or UN 1003

### **HU 4800 - Media and Globalization**

Examines the development of modern international communication systems, the rise of transnational media industries and technologies, and debates about their global impacts.

**Credits:** 3.0

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

**Semesters Offered:** Spring

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

**Pre-Requisite(s):** UN 1001

### **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 4961 - Practicum in TESOL**

Observation, case studies, tutoring, instructional assistance, and supervised teaching experience in English to speakers of other languages.

**Credits:** variable to 6.0; Repeatable to a Max of 6

**Semesters Offered:** Fall, Spring, Summer

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

**Pre-Requisite(s):** HU 3962

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## **International Exchange**

### **IEX 2001 - International Exchange**

**Credits:** variable to 15.0

**Semesters Offered:** Fall

### **IEX 2002 - International Exchange**

**Credits:** variable to 15.0

**Semesters Offered:** Spring

### **IEX 2003 - International Exchange**

**Credits:** variable to 15.0

**Semesters Offered:** Summer

### **IEX 3001 - International Exchange**

**Credits:** variable to 15.0

**Semesters Offered:** Fall, Spring, Summer

### **IEX 3002 - International Exchange**

**Credits:** variable to 15.0

**Semesters Offered:** Spring

### **IEX 3003 - International Exchange**

**Credits:** variable to 15.0

**Semesters Offered:** Summer

### **IEX 4001 - International Exchange**

**Credits:** variable to 15.0

**Semesters Offered:** Fall

### **IEX 4002 - International Exchange**

**Credits:** variable to 15.0

**Semesters Offered:** Spring

### **IEX 4003 - International Exchange**

**Credits:** variable to 15.0

**Semesters Offered:** Summer

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## **Mathematical Sciences**

### **MA 0010 - Development of Mathematics Skills**

Individualized instruction in mathematics problem solving and general study skills from professional math coaches. Helps students with demanding college-level mathematics courses. Credits do not count toward graduation.

**Credits:** 0.0; May be repeated

**Semesters Offered:** Fall, Spring

**Restrictions:** Permission of instructor required

### **MA 0030 - Team Approach for College Algebra**

Collaborative approach to the study of mathematics. Helps students with MA1030 and gives experience in team problem solving. Credit does not count toward graduation.

**Credits:** 0.0; May be repeated

**Semesters Offered:** Fall, Spring, 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 (BS), Scientific & Tech Comm (BS), Liberal Arts, Psychology, Social Sciences, Liberal Arts with History Opt, Scientific & Tech Comm (BA), Humanities, Theatre & Entertain Tech (BA)

### **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

**Co-Requisite(s):** MA 0031

**Pre-Requisite(s):** MA 1030

### **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:** (0-4-0)

**Semesters Offered:** Fall, Spring, Summer

**Pre-Requisite(s):** ACT Mathematics  $\geq$  19 or SAT Mathematics  $\geq$  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)

**Semesters Offered:** Fall, Spring, Summer

**Restrictions:** May not be enrolled in one of the following College(s): College of Engineering

**Pre-Requisite(s):** MA 1032 or MA 1031 or ACT Mathematics  $\geq$  26 or SAT Mathematics  $\geq$  600

**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)

**Semesters Offered:** Fall, Spring

**Pre-Requisite(s):** MA 1032 or MA 1031 or ACT Mathematics  $\geq$  29 or SAT Mathematics  $\geq$  650

**MA 1161 - Calculus Plus w/ Technology I**

An introduction to single-variable calculus, which includes a computer laboratory. Topics include trigonometric, exponential, logarithmic functions, differentiation and its uses, and basic integration. Integrates symbolic tools, data and numerics, and graphical concepts and is similar to MA1160, going at a slower pace and incorporating cooperative learning study skills.

**Credits:** 5.0

**Lec-Rec-Lab:** (0-5-0)

**Semesters Offered:** Fall, Spring, Summer

**Pre-Requisite(s):** MA 1032 or MA 1031 or ACT Mathematics  $\geq$  26 or SAT Mathematics  $\geq$  600

**MA 1910 - Exploring Symmetry Groups**

Mathematical discovery and invention in group theory: transformations, finite figures, strip patterns, wall patterns, finite groups, and Cayley diagrams. Develops the ability to find and describe patterns, to generalize from observations, to formulate conjectures, and to support conjectures with analysis and, when possible, formal proof.

**Credits:** 3.0

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

**Semesters Offered:** Fall - Offered alternate years beginning with the 2000-2001 academic year

**MA 1920 - Exploring Knots and Surfaces**

Mathematical discovery and invention in topological graph theory: networks, graphs, graph coloring, surfaces and graphs, and knots. Develops the ability to find and describe patterns, to generalize from observations, to formulate conjectures, and to support conjectures with analysis and, when possible, formal proof.

**Credits:** 3.0

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

**Semesters Offered:** Fall - Offered alternate years beginning with the 2001-2002 academic year

**MA 1930 - Exploring Number Theory**

Mathematical discovery and invention in number theory: number puzzles, Chinese Remainder Theorem, codes, primitive roots, and quadratic reciprocity. Develops the ability to find and describe patterns, to generalize from observations, to formulate conjectures, and to support conjectures with analysis and, when possible, formal proof.

**Credits:** 3.0

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

**Semesters Offered:** Fall - Offered alternate years beginning with the 2006-2007 academic year

**MA 1940 - Exploring Non-Euclidean Geometry**

Mathematical discovery and invention in Non-Euclidean geometry: definitions of straight and angle, transformations, congruence, parallel transport, projections, and finite geometries. Develops the ability to find and describe patterns, to generalize from observations, to formulate conjectures, and to support conjectures with analysis and, when possible, formal proof.

**Credits:** 3.0

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

**Semesters Offered:** Fall - Offered alternate years beginning with the 2003-2004 academic year

**MA 1990 - Elementary Mathematics Topics**

Students study a particular area in mathematics, ordinarily not covered in existing courses. Intended for first-year students.

**Credits:** variable to 6.0; Repeatable to a Max of 6

**Semesters Offered:** Fall, Spring, Summer

**Restrictions:** Permission of instructor required

**MA 2010 - Recreational Mathematics**

Topics include such things as fair division, time travel, maze threading, logic puzzles and paradoxes, famous math problems and solutions, cryptarithmic 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:** On Demand

**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 1160 or MA 1161 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 1160 or MA 1161

**MA 2321 - Elementary Linear Algebra**

Offered first half of semester, to be taken concurrently with MA3521. The course is an introduction to linear algebra and how it can be used. Topics include systems of equations, vectors, matrices, orthogonality, subspaces and the eigenvalue problem. Not open to students with credit in MA2320 or MA2330.

**Credits:** 2.0

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

**Semesters Offered:** Fall, Spring

**Restrictions:** May not be enrolled in one of the following Major(s): Mathematics, 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 1160 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 MA2720 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 2720 - Statistical Methods**

Introduction to the design and analysis of statistical studies. Topics include methods of data collection, descriptive and graphical methods, probability, statistical inference on means, regression and correlation, and single variable ANOVA. Not open to students with credit in 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 1030

**MA 2910 - Mathematical Experimentation**

Mathematical discovery and invention in topics such as algebra, analysis, applied mathematics, discrete mathematics, geometry, and statistics. Class projects require students to find and describe patterns, generalize from observations, formulate and support conjectures with analysis and, when possible, proof. Projects require written reports describing the student's findings, conjectures, and conclusions. Course prerequisite is any math course numbered MA1090 or higher.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** MA 1160 or MA 1161

**MA 2990 - Elementary Topics in Mathematics**

Students study a particular area in mathematics ordinarily not covered in 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

**Co-Requisite(s):** MA 2321

**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 3560 - Mathematical Modeling with Differential Equations**

Creating differential equation models for physical problems such as population dynamics, kinetics, mass-spring systems. Topics include nondimensionalization, numerical methods, phase-plane analysis, first-order systems, linearization, and stability. Includes modeling case studies, using a computer algebra system, and a modeling project. Not open to students with credit in MA3520, MA3521, or MA3530.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** MA 2160 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, Summer

**Restrictions:** May not be enrolled in one of the following Major(s): Electrical Engineering

**Pre-Requisite(s):** MA 3160

**MA 3740 - Statistical Programming and Analysis**

Use of statistical packages R and SAS to process and analyze data. Topics include: data import and manipulation, production of copy quality graphs, use of basic statistical methods, and some advanced programming techniques.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** MA 2710 or MA 2720 or MA 3710

**MA 3810 - Introduction to Actuarial Mathematics**

Nominal and effective rates of interest, present value, discount, annuities certain, sinking funds, bonds, yield rates, and amortization schedules. Financial calculator skills for professional exams. Introduction to derivative securities and arbitrage pricing. May include other topics on the FM exam.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Co-Requisite(s):** MA 3720

**Pre-Requisite(s):** MA 3160(C)

**MA 3811 - Actuarial Exam Workshop**

Topics from the Society of Actuaries professional examinations, primarily financial mathematics and probability. Review, preparation, and practice using SOA exams and other materials.

**Credits:** 1.0; Repeatable to a Max of 4; Graded Pass/Fail Only

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

**Semesters Offered:** Fall, Spring

**Pre-Requisite(s):** MA 3160

**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**

Optimal and best strategies for finite 2-person games of strategy. Psychology of game playing. Bluffing, bargaining, threats, coalitions. Applications to warfare, economics, sociology, politics, and everyday life.

**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 3999 - Intermediate Topics in Mathematics**

Students study a particular area in mathematics, not ordinarily covered in existing courses. Intended for third-year students.

**Credits:** variable to 4.0; Repeatable to a Max of 6

**Semesters Offered:** Fall, Spring, Summer

**Restrictions:** Permission of instructor required

**MA 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 3210

**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:** Fall

**Pre-Requisite(s):** MA 3210

**MA 4310 - Abstract Algebra**

Detailed study of abstract algebra: elementary number theory (congruences, quadratic residues, arithmetic functions), group theory (monoids, permutation groups, homomorphisms, quotients, Lagrange's theorem, finite abelian groups, Sylow's theorems), ring theory (domains, prime and maximal ideals, quotients, PID's), splitting fields, finite fields.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** MA 3310

**MA 4330 - Linear Algebra**

A study of fundamental ideas in linear algebra and its applications. Includes review of basic operations, block computations; eigensystems of normal matrices; canonical forms and factorizations; singular value decompositions, pseudo inverses, least-square applications; matrix exponentials and linear systems of ODEs; quadratic forms, extremal properties, and bilinear forms.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** (MA 2320 or MA 2321 or MA 2330) and MA 3160

**MA 4410 - Complex Variables**

A study of complex numbers, functions of a complex variable, analytic functions, elementary functions, integrals, Taylor and Laurent series, residues and poles, and conformal mapping.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** MA 3160

**MA 4450 - Real Analysis**

Real analysis on Euclidean n-space. Topics include real and vector valued functions, metric and normed linear spaces; an introduction to Lebesgue measure and convergence theorems.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** (MA 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 4525 - Applied Vector and Tensor Mathematics**

Introduction to vector and tensor mathematics with applications. Topics include vectors; vector differential calculus, space curves; dyadic products and matrices; gradients, divergence, curl, Laplacians; Stokes' integral theorem, Gauss theorem, conservation laws; curvilinear coordinates; tensors, material derivatives; applications of potential theory in electricity and magnetism, heat transfer, solid and fluid mechanics.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** MA 3160 and (MA 2320 or MA 2321 or MA 2330)

**MA 4535 - Nonlinear Dynamics and Chaos**

Ordinary differential equations and dynamical systems via a modern geometric approach, including physical and engineering applications. May include chaotic phenomena and fractals.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** (MA 3520 or MA 3521 or MA 3530 or MA 3560) and MA 3160

**MA 4610 - Numerical Linear Algebra**

Derivation and analysis of algorithms for problems in linear algebra. Covers floating point arithmetic, condition numbers, error analysis; solution of linear systems (direct and iterative methods), eigenvalue problems, least squares, singular value decomposition. Includes a review of elementary linear algebra and the use of appropriate software.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** MA 2320 or MA 2321 or MA 2330

**MA 4620 - Finite Difference Methods for PDEs**

Derivation, analysis, and implementation of numerical methods for partial differential equations; applications to fluid mechanics, elasticity, heat conduction, acoustics, or electromagnetism.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** (MA 3520 or MA 3521 or MA 3530 or MA 3560) and MA 3160

**MA 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

**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, multicollinearity, model diagnostics and variable selection. A statistical computing package is an integral part of the course.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** MA 2720 or MA 3710

**MA 4720 - Design and Analysis of Experiments**

Covers construction and analysis of completely randomized, randomized block, incomplete block, Latin squares, factorial, fractional factorial, nested and split-plot designs. Also examines fixed, random and mixed effects models and multiple comparisons and contrasts. The SAS statistical package is an integral part of the course.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** MA 2710 or MA 2720 or MA 3710

**MA 4740 - Sampling Methods**

Topics include survey construction, sources of error in surveys, estimation of population parameters from simple random, stratified, systematic, and multi-stage 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 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 4780 - Time Series Analysis and Forecasting**

Topics in time series analysis and forecasting. Trend analysis, smoothing, Box-Jenkins models, model selection and testing, time series regression.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** MA 2710 or MA 2720 or MA 3710

**MA 4810 - Life Contingencies**

Life tables. Basic forms of life insurance, life annuities, gross and net premiums, reserves, cash values, expense loadings, and commutation functions. Joint-life, last survivor, and reversionary functions, Derivative Securities, hedging. May include other topics on MLC and MFE exams.

**Credits:** 3.0

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

**Semesters Offered:** Spring - Offered alternate years beginning with the 2004-2005 academic year

**Pre-Requisite(s):** MA 3720 or MA 3810

**MA 4820 - Loss Distributions and Credibility Theory**

Loss distribution studies probability distributions that are used for modeling the outcomes of insurance claims. Credibility theory addresses methods for updating statistical estimates as new data becomes available. May include other topics on the C exam.

**Credits:** 3.0

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

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

**Pre-Requisite(s):** MA 3720

**MA 4900 - Mathematical Sciences Project**

Independent study in an area of mathematical sciences under the guidance of a faculty member.

**Credits:** variable to 4.0; Repeatable to a Max of 6

**Semesters Offered:** Fall, Spring, Summer

**Restrictions:** Permission of instructor required

**MA 4905 - Methods of Teaching Mathematics**

This course focuses on trends and standards in secondary school mathematics education, with an emphasis on methods and materials for effectively supporting and assessing middle and high school learning. Requires admission to teacher education program.

**Credits:** 2.0

**Lec-Rec-Lab:** (0-1-2)

**Semesters Offered:** Spring

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

**Pre-Requisite(s):** ED 4700(C)

**MA 4908 - Theory of Numbers with Technology**

Mathematical induction, Euclid's algorithm, prime and composite integers, algebra of congruences, Chinese remainder theorem, quadratic reciprocity law, number theoretic functions, first degree Diophantine equations, Pythagorean triples, Fermat and Mersenne numbers, factoring algorithms, tests for primality and various applications. Projects use Mathematica and EXCEL software packages.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** MA 3210 or MA 3310 or MA 3924

**MA 4945 - History of Mathematics**

Survey of the development of mathematics from ancient times to today. How cultural, mathematical, and technological developments have influenced one another throughout history. Course provides all necessary historical background.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**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

**Mechanical Engineering - Engineering Mechanics****MEEM 2110 - Statics**

Force systems in two and three dimensions. Includes composition and resolution of forces and force systems, principles of equilibrium applied to various bodies, simple structures, friction, centroids, and moments of inertia. Vector algebra used where appropriate.

**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):** MA 2160 and (CH 1150 and CH 1151)

**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 or TE 1020) and (MY 2100(C) or MET 1540(C))

**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**

Dynamic behavior of single degree-of-freedom systems. Free and forced vibration with an emphasis on harmonic motion. Vibration considerations in design; vibration isolation, balancing, and transmissibility. Free and forced vibration of multiple degree-of-freedom systems. Laplace transform solutions for periodic and transient inputs. Introduction to system modeling.

**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**

Basic concepts of three-dimensional stress and strain. Inelastic behavior of axial members, circular shafts and symmetric beams. Deflections of indeterminate beams. Unsymmetrical bending, shear flow and shear center for open sections. Energy methods for structures made up of one-dimensional elements. Introduction to theories of failures for anisotropic 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 Materials in Mechanics**

Identifies the modes of mechanical failure that are essential to prediction and prevention of mechanical failure. Discusses theories of failure in detail. Treats the topic of fatigue failure extensively and brittle fracture, impact and buckling failures at some length.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** MEEM 3501

**MEEM 4180 - Engineering Biomechanics**

Engineering mechanics applied to the human body in health and disease or injury, which includes mechanics of human biological materials and engineering design in musculo-skeletal system. Also studies on mechanics of posture (occupational biomechanics) and locomotion (sports biomechanics) using mathematical models of the human body. Credit may not be received for both 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:** Fall - Offered alternate years beginning with the 2005-2006 academic year

**Pre-Requisite(s):** MEEM 3230(C) or CM 3230 or ENG 3200 or MY 3100

**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:** Spring

**Pre-Requisite(s):** MEEM 3210

**MEEM 4240 - Combustion & Air Pollution**

Introduces sources of emissions from combustion, applies thermo-chemical principles to model the formation of pollutants, and identifies impacts of air pollutants on the environment and human health. Addresses pollution regulation and societal impacts including emissions, climate change, and air quality.

**Credits:** 3.0

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

**Semesters Offered:** 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 4260 - Fuel Cell Technology**

In this course, after fuel cell technology basics and operating principles, fuel cell performance will be briefly described from energy and thermodynamic viewpoints. Major types of fuel cells will be discussed: Polymer Electrolyte Membrane Fuel Cell (PEMFC), Direct Methanol Fuel Cells (DMFC), Alkaline Fuel Cells (AFC), Phosphoric Acid Fuel Cell (PAFC), Molten Carbonate Fuel Cell (MCFC) and Solid Oxide Fuel Cell (SOFC). The balance of the fuel cell power plant, thermal system design and analysis will be discussed that affect the power generation. Finally, the components needed, issues related, and pertinent analysis will be covered to delivering electric power generated from the fuel cell.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Restrictions:** Must be enrolled in one of the following College(s): College of Engineering; Must be enrolled in one of the following Class(es): Senior

**Pre-Requisite(s):** MEEM 3230 or CM 3110

**MEEM 4295 - Introduction to Propulsion Systems for Hybrid Electric Vehicles**

Hybrid electric vehicle analysis will be developed and applied to examine the operation, integration, and design of powertrain components. Model based simulation and design is applied to determine vehicle performance measures in comparison to vehicle technical specifications. Power flows, losses, energy usage, and drive quality are examined over drive-cycles via application of these tools.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Restrictions:** Must be enrolled in one of the following College(s): College of Engineering; May not be enrolled in one of the following Class(es): Freshman, Sophomore

**Pre-Requisite(s):** (MEEM 2200 or ENG 3200) and MEEM 4700 or EE 4261

**MEEM 4296 - Introduction to Propulsion Systems for Hybrid Electric Vehicles Laboratory**

Hybrid electric vehicles and their powertrain components will be examined from the aspects of safety, testing and analysis, energy conversion, losses, and energy storage, and vehicle technical specifications and vehicle development process. The lab will culminate with vehicle testing to perform power flow and energy analysis during a drive-cycle.

**Credits:** 2.0

**Lec-Rec-Lab:** (0-1-2)

**Semesters Offered:** Fall, Summer

**Restrictions:** Must be enrolled in one of the following College(s): College of Engineering; May not be enrolled in one of the following Class(es): Freshman, Sophomore

**Pre-Requisite(s):** MEEM 4295(C) or EE 4295(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, Summer

**Restrictions:** Must be enrolled in one of the following Major(s): Mechanical Engineering, Mechanical Eng-Eng Mechanics, Engineering-Manufacturing; May not be enrolled in one of the following Class(es): Freshman, Sophomore

**Pre-Requisite(s):** ENG 1102

**MEEM 4404 - Mechanism 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 4405 - Intro to the Finite Element Method**

Introduces the use of the finite element method in stress analysis and heat transfer. Emphasizes the modeling assumptions associated with different elements and uses the computer to solve many different types of stress analysis problems, including thermal stress analysis and introductory nonlinear analysis.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring, Summer

**Pre-Requisite(s):** MEEM 3502 and (MA 2320 or MA 2321 or MA 2330) and (MA 3520 or MA 3521 or MA 3530 or MA 3560)

**MEEM 4450 - Vehicle Dynamics**

This course will develop the necessary models to predict performance and handling and compare analytical results to selected measured data from hybrid vehicle test data. Topics to be covered include: acceleration and braking performance, hybrid electric powertrain architecture, drivetrain performance, vehicle handling, suspension modeling, tire models, steering and steering control, 2DOF dynamics model, and multi-body dynamics. This will culminate in a design project which will require the design of a hybrid vehicle to meet a given vehicle technical specification.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Restrictions:** Must be enrolled in one of the following College(s): College of Engineering

**Pre-Requisite(s):** (MEEM 3502 and MEEM 3000) or (EE 3305 and MEEM 2700)

**MEEM 4610 - Advanced Machining Processes**

Covers mechanics of 2-D and 3-D cutting and their extension to commonly used conventional processes such as turning, boring, milling, and drilling. Topics include force modeling, surface generation, heat transfer, tool life and dynamics.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** MEEM 2500

**MEEM 4615 - Metal Forming Processes**

Covers analytical and experimental study of metal forming processes, such as forging, extrusion, rolling, bending, stretch forming, and deep drawing as well as progressive die design for sheet metal stamping and design of dies for bulk forming.

**Credits:** 4.0

**Lec-Rec-Lab:** (0-3-2)

**Semesters Offered:** Fall, Spring

**Pre-Requisite(s):** MEEM 2500 and MEEM 2150

**MEEM 4625 - Precision Manuf and Metrology**

Course presents theory and practice involved in manufacturing and measuring of precision components. Topics include precision machining processes, precision machine/mechanism design, and dimensional metrology. Also discusses current manufacturing challenges in the bearings, optics, and microelectronics industries.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring

**Pre-Requisite(s):** MEEM 3700(C) and MEEM 3502(C)

**MEEM 4630 - Human Factors**

The usability of products and systems can be improved by considering human capabilities during their design. This course explores both the psychological and physical characteristics of human beings. It then presents how to apply human factors principles to the design process. Degree credit cannot be received for both MEEM4630 and SSE3400.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**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:** (0-3-0)

**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 services and products are created and how they are delivered to customers.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring

**Pre-Requisite(s):** MEEM 3501(C)

**MEEM 4660 - Data Based Modeling & Control**

System modeling 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 4701 - Analy and Exp Modal Analysis**

Combined experimental and analytical approach to mechanical vibration issues; characterization of the dynamic behavior of a structure in terms of its modal parameters; digital data acquisition and signal processing; experimental modal analysis procedures; parameter estimation for obtaining modal parameters; model validation and correlation with analytical models; structural dynamics modification.

**Credits:** 4.0

**Lec-Rec-Lab:** (0-3-2)

**Semesters Offered:** Fall

**Pre-Requisite(s):** MEEM 3000 and MEEM 3700

**MEEM 4704 - Acoustics and Noise Control**

Analysis and solution of practical environmental noise problems. Fundamental concepts of sound generation and propagation, the unwanted effects of noise, assessment of sound quality, and source-path-receiver concepts in noise control. Lecture, measurement laboratory, and team project directed at solving a real noise problem under a client's sponsorship.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** MA 3160 and MEEM 2700

**MEEM 4705 - Introduction to Robotics and Mechatronics**

Cross-discipline system integration of sensors, actuators, and microprocessors to achieve high-level design requirements, including robotic systems. A variety of sensor and actuation types are introduced, from both a practical and a mathematical perspective. Embedded microprocessor applications are developed using the C programming language.

**Credits:** 4.0

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

**Semesters Offered:** Fall, Spring

**Pre-Requisite(s):** MEEM 4700(C)

**MEEM 4720 - Space Mechanics**

This course presents the vector-based solution of the two-body problem and the solution for Kepler's equations. The course will also cover basic orbit determination techniques, impulsive orbit transfer maneuvers, interplanetary trajectories, ground tracks, and rendezvous problems.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** MEEM 2700

**MEEM 4750 - Distributed Embedded Control Systems**

This course will develop an understanding for the design and application of embedded control systems. Topics to be covered include: embedded system architecture, model-based embedded system design, real-time control, communication protocols, signal processing, and human machine interface. Embedded applications in advanced hybrid electric vehicles will also be introduced.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Restrictions:** Must be enrolled in one of the following College(s): College of Engineering

**Pre-Requisite(s):** MEEM 4700 or EE 4261

**MEEM 4901 - Senior Capstone Design I**

Students work in teams on "open-ended" engineering capstone design projects - most with industrial sponsors - developing original and creative solutions to real engineering problems.

**Credits:** 2.0

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

**Semesters Offered:** Fall, Spring

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

**Pre-Requisite(s):** MEEM 3000(C) and MEEM 3502(C) and MEEM 3900

**MEEM 4911 - Senior Capstone Design II**

Design projects started in MEEM4901 are completed and evaluated using computer-aided engineering methods, physical models, and/or prototypes as appropriate.

**Credits:** 2.0

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

**Semesters Offered:** Fall, Spring

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

**Pre-Requisite(s):** MEEM 4901

**MEEM 4990 - Special Topics in Mech Engg**

Problems in mechanical engineering, engineering mechanics, manufacturing, or industrial engineering that are not covered in regular courses.

**Credits:** variable to 6.0; Repeatable to a Max of 6

**Semesters Offered:** Fall, Spring, Summer

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

**MEEM 4999 - Mechanical Engineering Senior Research Thesis**

An undergraduate research experience during the senior year in mechanical engineering. Students begin work on an active research project/grant with faculty or continue work from the previous year. A thesis will be published in the department and archived.

**Credits:** 3.0; Repeatable to a Max of 6

**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, Junior



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## Mechanical Engineering 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 1000 or (CH 1150 and CH 1151)

### MET 2120 - Statics and Strength of Materials

Statics includes the study of forces, analysis of simple structures, equilibrium, moment of inertia, and friction. Materials considers stress and strain under axial, torsional, and bending loads. Laboratory exercises include materials testing and problem solving.

**Credits:** 4.0

**Lec-Rec-Lab:** (0-3-2)

**Semesters Offered:** Fall

**Pre-Requisite(s):** (MA 1160(C) or MA 1161(C)) and (PH 1140 or PH 1110)

### MET 2130 - Dynamics

Particle and rigid plane body kinematics and kinetics covers inertia force, work-energy-power and impulse-momentum methods. Emphasizes development of student skills in problem definition and problem solving.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** MET 2120

### MET 2153 - Machine Tool Fundamentals and Applications

A study of basic machining processes: including setup and operation of lathes, milling machines, drill presses, grinders and saws. Students are exposed to fundamental machining processes, nomenclature and machine operation with an overall focus on safety and quality control.

**Credits:** 2.0

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

**Semesters Offered:** Fall

### 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 3361 - Applied Thermodynamics and Heat Transfer

An introduction to the basic principles and applications of engineering thermodynamics and heat transfer for engineering technology students. Emphasizes design and evaluation of practical engineering systems.

**Credits:** 4.0

**Lec-Rec-Lab:** (0-3-2)

**Semesters Offered:** Spring

**Pre-Requisite(s):** MET 3250

### MET 3451 - Machine Design II

This course extends the study of mechanical design begun in MET3242, Machine Design I and looks at more complex components and systems. Design projects are given special emphasis.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** MET 3242

### MET 4210 - Applied Quality Techniques

Basic knowledge required to improve processes in the workplace. Includes the design of simple experiments, statistical process control, lean methodologies, and corrective and preventative action.

**Credits:** 3.0

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

**Semesters Offered:** Fall

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

**Pre-Requisite(s):** MA 2720(C)

### 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

**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

**Pre-Requisite(s):** MET 3361

### 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

**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 4510 - Lean Manufacturing and Production Planning

Modern methods for the systematic planning and control of operations and an understanding of lean manufacturing concepts. Focus is on reduced lead times and elimination of waste.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Restrictions:** Must be enrolled in one of the following Class(es): Junior, Senior

### MET 4550 - Computer Aided Manufacturing

Course is designed to apply techniques used in parametric modeling (CAD) and convert this information to all phases of production planning, machining, scheduling and quality control.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Restrictions:** Must be enrolled in one of the following Class(es): Junior, Senior

**Pre-Requisite(s):** MEEM 2500 and MET 2400

### MET 4585 - Facilities Layout and Safety Design

Examines the optimization concepts and safety topics necessary to design a low risk, high efficiency manufacturing facility layout. The focus will be on quantitative tools, flow analysis techniques, hazard recognition and resource selection.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Restrictions:** Must be enrolled in one of the following Class(es): Junior, Senior

### **MET 4660 - CAE and FEA Methods**

Comprehensive use of both computer derived solutions and experimental validation of analytical and finite element solutions using methods such as strain gage testing.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Restrictions:** Must be enrolled in one of the following Class(es): Junior, Senior

**Pre-Requisite(s):** MET 2400 and MET 3451

### **MET 4670 - Senior Project**

Completion and evaluation of design projects using computer-aided engineering methods, physical models, and/or prototypes. Evaluation and design optimization methods for efficient and cost-effective designs. Oral/written report and comprehensive exam.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring, Summer

**Restrictions:** Permission of instructor required; Must be enrolled in one of the following Class(es): Senior

**Pre-Requisite(s):** MET 4460

### **MET 4780 - Advanced Manufacturing**

An introduction to advanced manufacturing processes, both traditional and nontraditional. Study of both theory and practice will be tied to laboratory experiments utilizing a spectrum of unique materials and methods.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-2-3)

**Semesters Offered:** Spring

**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

**Restrictions:** Must be enrolled in one of the following Class(es): Junior, Senior

**Pre-Requisite(s):** MET 3361(C)

### **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 problem/project.

**Credits:** variable to 3.0; Repeatable to a Max of 6

**Semesters Offered:** On Demand

**Restrictions:** Permission of instructor required; Must be enrolled in one of the following Major(s): Mechanical Engineering Tech; Must be enrolled in one of the following Class(es): Senior

### **MET 4998 - Undergraduate Research in Mechanical Engineering Technology**

An undergraduate research experience in Mechanical Engineering Technology. Under the guidance of a Mechanical Engineering Technology faculty member, students work on a selected/approved research problem or work directly with faculty on active research projects/grants. May require more than one semester to complete.

**Credits:** variable to 6.0; Repeatable to a Max of 6

**Semesters Offered:** On Demand

**Restrictions:** Permission of instructor required; Must be enrolled in one of the following Major(s): Mechanical Engineering Tech; Must be enrolled in one of the following Class(es): Senior

### **MET 4999 - Professional Practice Seminar**

Course designed to review and evaluate the program objectives linked with industrial partners and accreditation body. Focus given to preparing the student to take the 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

## **Management**

### **MGT 2000 - Team Dynamics and Decision Making**

Develops individual and group problem-solving skills using active, hands-on learning. Emphasizes problem identification and problem solution under conditions of ambiguity and uncertainty. Stresses creativity, interpersonal skills and skill assessment, communication, group process and teamwork, and action planning.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring, Summer

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

### **MGT 3000 - Organizational Behavior**

Covers concepts of human relations and organizational behavior through the study of people's behavior at work. Develop understanding, attitudes, and skills leading to increased personal effectiveness.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring, Summer

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

### **MGT 3100 - Leadership Development**

Assesses students' current knowledge, abilities and values relevant to leadership and guides students in developing and implementing plans for new leadership abilities.

**Credits:** 3.0

**Lec-Rec-Lab:** (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

### **MGT 3650 - Intellectual Property Management**

Covers principles of intellectual property law, addressing managerial and policy issues in copyright, trademark, trade secret, and patents. Readings and discussions also cover how these property and legal systems impact the balance between property exclusivity, technological innovation and public access.

**Credits:** 3.0

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

**Semesters Offered:** Fall

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

### **MGT 3800 - Entrepreneurship**

Covers management issues associated with establishing a successful new enterprises as a small businesses or part of an existing firm. Emphasizes learning through creation of a business plan as well as case studies that develop an understanding of opportunity recognition, entrepreneurial teams, reward systems, financing alternatives, family ventures, ethical and legal contractual considerations, and resource needs.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring, Summer

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

### **MGT 4000 - Strategic Management**

Introduces 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 or MIS 2000) and (BA 3400 or FIN 3000) and (BA 3610 or OSM 3000) and (BA 3700 or MGT 3000) and (BA 3800 or MKT 3000)

### **MGT 4100 - 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. Examine 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:** Fall, Spring

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

**Pre-Requisite(s):** (BA 3700 or MGT 3000) and EC 3100(C)

**MGT 4500 - Managing Change in Organizations**

Studies organizational theory with an emphasis on managing change in organizations. Examines forces for change in the external environment, methods for managing change (design and implementation), the impact of change on people, and leaders as agents of change. Case studies and student projects prepare the student to manage change in organizations.

**Credits:** 3.0

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

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

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

**Pre-Requisite(s):** BA 3700 or MGT 3000

**MGT 4600 - Management of Technology and Innovation**

Uses an evolutionary process perspective that examines how technology strategy evolves from underlying technology competences and capabilities, patterns of technological innovations, development of technological capabilities and competences, the role of collaboration in innovation, and profiting from new technologies.

**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

**MGT 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 or MGT 4600(C)

**MGT 4700 - Human Resource Management**

Examines methods that organizations use to meet organizational goals through influencing worker attitudes, behaviors, and performance. Topics include recruitment, selection, training, performance appraisal, and compensation.

**Credits:** 3.0

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

**Semesters Offered:** Spring

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

**Pre-Requisite(s):** BA 3700 or MGT 3000

**MGT 4800 - 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:** Fall, Spring

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

**MGT 4900 - Special Topics in Management**

Examines additional management topics and issues in greater depth. A single offering of this course will concentrate on one or two topics which vary.

**Credits:** 3.0

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

**Semesters Offered:** On Demand

**Restrictions:** Permission of instructor required

**Pre-Requisite(s):** BA 3700 or MGT 3000

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**Management Information Systems****MIS 2000 - IS/IT Management**

Focuses on the theory and application of the information-systems discipline within an organizational context, and identifies the roles of management, users, and information systems professionals. Covers the use of information systems and implications for decision support to improve business processes, and addresses the ethical, legal, and social issues of IT.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring, Summer

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

**Pre-Requisite(s):** BUS 1100 or BA 1100 or CS 1121 or CS 1131 or ENG 1101 or (ENG 1001 and ENG 1100) or SAT 1200

**MIS 2100 - Introduction to Business Programming**

Develops business problem solving skills through the application of a commonly used high-level business programming language. Topics include the nature of the business programming environment, fundamentals of the language (e.g., programming constructs, data management, manipulation of simple data structures), structured programming concepts, desirable programming practices and design, debugging and testing techniques.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**MIS 2200 - Web Programming**

Covers technologies, tools, and environments related to the development of web-enabled business solutions. Topics include the development environment for web-based solutions, key development technologies, desirable development practices, and design, programming, debugging and testing methods.

**Credits:** 3.0

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

**Semesters Offered:** Fall

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

**Pre-Requisite(s):** BA 2200 or MIS 2100 or CS 1121 or CS 1131

**MIS 3000 - Business Process Analysis**

Studies business decision management discipline using business rules, process models (e.g. flowcharts, unified modeling language, swim lanes), and information systems to improve efficiency and effectiveness. Emphasis on industry standards and business process management used to increase productivity.

**Credits:** 3.0

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

**Semesters Offered:** Fall - Offered alternate years beginning with the 2011-2012 academic year

**Pre-Requisite(s):** MIS 2000 or BA 3200

**MIS 3100 - Business Database Management**

Emphasizes database principles that are constant across different database software products through concrete examples using a relational database management system. Provides a well-rounded business perspective about developing, utilizing, and managing organizational databases.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** MIS 2000(C) or BA 3200

**MIS 3200 - Systems Analysis and Design**

Provides an understanding of the IS development and modification process and the evaluation choices of a system development methodology. Emphasizes effective communication with users and team members and others associated with the development and maintenance of the information system. Stresses analysis and logical design of departmental-level information system.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** MIS 2000(C) or BA 3200

**MIS 3300 - Telecommunications**

Introduces students to telecommunications concepts, architectures and protocols, commercial offerings, hardware, software, network design, and telecommunications management, regulations, and business applications (e-commerce).

**Credits:** 3.0

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

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

**Pre-Requisite(s):** MIS 2000(C) or BA 3200

**MIS 3400 - Business Intelligence**

Focuses on generation and interpretation of business analytics relative to organizational decision making. Includes core skills necessary for constructing data retrieval queries in a relational database environment.

**Credits:** 3.0

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

**Semesters Offered:** Spring - Offered alternate years beginning with the 2011-2012 academic year

**Pre-Requisite(s):** MIS 2000 or BA 3200

**MIS 3500 - User-Centered Design**

Studies user-centered design in development of effective interface solutions for business needs. Content may include input/output devices, user modeling, help and documentation, social issues, and usability evaluation. Emphasis on how interface design addresses human capabilities and capacities.

**Credits:** 3.0

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

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

**Pre-Requisite(s):** MIS 2000 or BA 3200

**MIS 3600 - Information Regulatory Compliance**

Focuses on understanding government regulations directly relevant to information systems practitioners and end users for the secure management of IT assets and capabilities. Coverage may include: global, national, and local regulations; security concerns; and individual, team, and organizational responsibilities (e.g. social engineering issues).

**Credits:** 3.0

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

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

**Pre-Requisite(s):** MIS 2000 or BA 3200

**MIS 4000 - 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):** (MIS 3100 or BA 3210) and (MIS 3200 or BA 3220)

**MIS 4100 - Information Systems Projects**

MIS capstone course. Previous completion of required MIS coursework expected. Applies IS practices and artifacts 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 3210 or MIS 3210) and (BA 3220 or MIS 3000 or MIS 3200)

**MIS 4900 - 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):** MIS 2000 or BA 3200

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## Marketing

**MKT 3000 - Principles of Marketing**

Emphasizes decisions made in developing both strategic and tactical marketing plans. Uses computer simulations, experiential learning assignments, and marketing plan development to demonstrate principles of market segmentation, product development, pricing, distribution planning, and promotion.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring, Summer

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

**MKT 3200 - Consumer Behavior**

Introduces students to the general concepts, processes, and variables pertinent to consumers' decision making and lifestyle choices. Discussions will be based on a variety of disciplines: psychology, sociology, economics, and anthropology.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** BA 3800 or MKT 3000

**MKT 3400 - Integrated Marketing Communications**

Discusses how a variety of marketing communication methods, such as advertising, public relations, sales promotion, point-of-purchase, and direct marketing are developed, implemented, and evaluated in an integrative manner.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** BA 3800 or MKT 3000

**MKT 3600 - Marketing Research**

Focuses on the application of the marketing research in marketing decision-making. Topics include survey methodology, research design, statistical analysis of data, and report writing.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** (MA 2710 or MA 2720 or MA 3710 or BUS 2100 or BA 2100) and (BA 3800 or MKT 3000)

**MKT 3800 - Marketing Strategy**

Focuses on the formulation and the implementation of marketing strategies. Topics include the analyses of business environment as well as marketing program development and evaluation.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** MKT 3000 or BA 3800

**MKT 4000 - New Products Marketing**

Explores strategic aspects of new product management. Topics include the process of new product development, product life-cycle management, brand management, and product commercialization strategy.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** MKT 3000 or BA 3800

**MKT 4100 - Sales and Sales Management**

Looks at the role of the selling function as an integral part of the total marketing effort. Examines the administrative functions of sales management, the dynamics of the buying-selling process, and sales strategies and tactics.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring

**Pre-Requisite(s):** BA 3800 or MKT 3000

**MKT 4200 - Business to Business Marketing**

Emphasis is on the firm's behavior and decision-making. Topics include the foundation of business value creation, business marketing programs development, and inter-firm relationship management.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** BA 3800 or MKT 3000

**MKT 4300 - Global Marketing**

Discusses the critical elements of international marketing strategy: socio-politico-economic environment, global consumer culture, entry strategy, and global marketing mix. Utilizes cases and examples in order for students to better understand the globalized marketplace.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** MKT 3000 or BA 3800

**MKT 4400 - Services Marketing**

Focuses on the difference from the marketing of products. Discusses various services in conjunction with their marketing strategy to enhance service quality and customer satisfaction. Covers both pure services and service-laden businesses: industrial products, high tech products, and durable goods.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** MKT 3000 or BA 3800

**MKT 4500 - Introduction to Digital Marketing**

The class will include, but is not limited to: online video lectures, interactive chats, blogging, completing digital marketing plans and an Internet Marketing text book supported by a student web site. Basic familiarity with the internet, search engines and social media is assumed.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** MKT 3000 or BA 3800

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## Materials Science & Engineering

### MY 2100 - Introduction to Materials Science and Engineering

Introduction to the structure, processing, properties, and performance of engineering materials, including metals, polymers, glasses, ceramics, and composites. Presents case studies covering selection of materials, component design, and analysis of component failures.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring, Summer

**Pre-Requisite(s):** CH 1112 or CH 1122 or (CH 1150 and CH 1151) or (CH 1160 and CH 1161)

### MY 2110 - Introduction to Materials Science and Engineering II

Continuation of MY2100 designed to address "core competencies" in the materials discipline. Materials processing methods are used as a vehicle to master concepts such as conservation principles, crystallography, imperfections, phase diagrams, microstructure, and develop mathematical skills and introduce computational tools.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-2-3)

**Semesters Offered:** Spring

**Pre-Requisite(s):** MY 2100

### MY 3100 - Materials Processing I

Classical chemical thermodynamics as applied to single and multicomponent materials systems. Topics include heat and mass balance, enthalpy, entropy, free energy, chemical reactions and equilibria, mass action, solution thermodynamics, phase diagram, stability/Pourbaix diagrams and electrochemistry.

**Credits:** 4.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** MY 2100 and MY 2110

### 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 and MY 2110

### MY 3210 - Materials Characterization II

Fundamentals of structural characterization. A continuation of Materials Characterization I which examines additional structural techniques such as thermal analysis, calorimetry, and particulate analysis, scanning tunneling, spectroscopy, and atomic force microscopy. Discusses the limitations/capabilities of basic characterization techniques as well as data analysis methods and practices.

**Credits:** 4.0

**Lec-Rec-Lab:** (2-1-3)

**Semesters Offered:** Spring

**Pre-Requisite(s):** MY 2100

### MY 3292 - Light and Photonic Materials

Material properties controlling light wave propagation in optical crystals and optical wave guides. Photonic crystals and photonic devices based on electrical, magnetic, and strain effects.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Restrictions:** Must be enrolled in one of the following Major(s): Physics, Applied Physics, Electrical Engineering, Materials Science and Engrg; Must be enrolled in one of the following Class(es): Junior, Senior

**Pre-Requisite(s):** PH 2200 or EE 2190 or EE 3140

### MY 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 3701 - Introduction to Semiconductor Materials Science and Engineering

An introduction to the materials science and engineering of semiconductors. Topics include: semiconductor material electronic, thermal, and optical properties, how these properties are modified, how elementary devices made from these materials operate, and how device function depends on materials selection and processing.

**Credits:** 2.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** PH 2400

### MY 4130 - Principles of Metal Casting

Principles of metal casting, including melting practice, casting design, mold design, heat transfer and solidification, fluid flow and gating design. Introduction to computer simulation techniques for mold filling, solidification, and development of residual stress. Structure-property relations in cast metals. Recycling and environmental issues of the cast metals industry.

**Credits:** 3.0

**Lec-Rec-Lab:** (2-0-3)

**Semesters Offered:** Fall

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

**Pre-Requisite(s):** MY 2100

### MY 4140 - Science of Ceramic Materials

The structure, defect chemistry, and properties of crystalline and amorphous ceramics. Utilization of these materials in a variety of applications such as electrolytes in fuel cells and as bioceramics are examined.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** MY 2100

### MY 4155 - Composite Materials

Mechanistic aspects of property development in metal, ceramic, and polymeric composites. The role of composite architecture, processing, and microstructure on properties.

**Credits:** 3.0

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

**Semesters Offered:** Spring

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

**Pre-Requisite(s):** MY 2100

### MY 4165 - Corrosion and Environmental Effects

Mechanisms of corrosion processes, electrochemical and oxidation kinetics, and fundamentals of corrosion engineering.

**Credits:** 3.0

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

**Semesters Offered:** 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

**Restrictions:** Must be enrolled in one of the following Major(s): Materials Science and Engrg

**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 4300 - Mechanical Behavior of Materials**

An introduction to the deformation and fracture behavior of materials. Topics include multiaxial stress and strain, elastic and plastic deformation, hardening mechanisms, viscoelasticity, fracture, fatigue, creep, and microstructure/property relationships.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** MY 2100 and (MEEM 2150 or ENG 2120)

**MY 4310 - Practical Scanning Probe Microscopy for Undergraduates**

In this course, students will learn the design and fundamental physics behind scanning probe microscopy (SPM) techniques. Laboratories will include basic training in the operation of SPM instruments available at MTU, and the exploration of their capabilities during assigned team projects.

**Credits:** 1.0

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

**Semesters Offered:** On Demand - Offered alternate years beginning with the 2011-2012 academic year

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

**MY 4600 - Introduction to Polymer Engineering**

Basics in polymer science including molecular characteristics, synthesis, structure and properties of polymers. Various processing techniques and mechanical/ structural applications of polymers.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** MY 2100

**MY 4740 - Hydrometallurgy/Pyrometallurgy**

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

**Credits:** 4.0

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

**Semesters Offered:** Spring

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

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

**MY 4800 - Material and Process Selection in Design**

The principles of materials selection for engineering design. Topics include selection based on strength, stiffness, thermal properties, high temperature behavior, corrosion resistance, formability, joinability, manufacturability, recyclability, etc. Considers ethics and economics. Presents numerous case studies and examples.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** MY 2100

**MY 4920 - Materials Science & Engineering Senior Design Project I**

Conducted in teams of students working with industrial partners. Open to all engineering majors interested in interdisciplinary senior design projects. Non-MSE majors must be senior project ready as defined by their major program and obtain permission of the MSE department.

**Credits:** 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):** MY 4940

**Pre-Requisite(s):** MY 3110 and MY 3200 and MY 3210 and MY 3300

**MY 4930 - Materials Science & Engineering Senior Design Project II**

Senior design project conducted in teams of students working with an industrial partner. Open to all engineering majors interested in interdisciplinary senior design projects. Senior project ready as defined by major substitutes for prerequisites.

**Credits:** 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 4920

**MY 4940 - Materials Science and Engineering Design of Experiments**

Six Sigma strategy to solving materials engineering problems, including: Define-Measure-Analyze-Improve- Control to reduce process variation, Design for Six Sigma tools for new process development, and the use of Minitab software in statistical engineering methods. Communication and teaming skills are also addressed.

**Credits:** 2.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** MY 3110 and MY 3200 and MY 3210 and MY 3300

**MY 4970 - Special Topics - Materials**

Special topics in materials science and engineering.

**Credits:** variable to 4.0; May be repeated

**Semesters Offered:** Fall, Spring, Summer

**Restrictions:** Permission of instructor required

**MY 4990 - Undergraduate Research**

Undergraduate research in materials science and engineering. Independent research conducted under the guidance of a faculty member.

**Credits:** variable to 6.0; May be repeated

**Semesters Offered:** Fall, Spring, Summer

**Restrictions:** Permission of instructor required

**Operations & System Management****OSM 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 basic quality tools, and service systems engineering examples.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**OSM 3000 - Operations and Supply Chain Management**

Fundamental principles of operations and supply chain management; includes strategic importance and relevant interrelated concepts and tools in product/process design, work systems, forecasting, inventory and materials management, just-in-time, scheduling, and capacity management.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring, Summer

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

**Pre-Requisite(s):** MA 2710 or MA 2720 or MA 3710 or EET 2010 or BUS 2100 or BA 2100

**OSM 3100 - 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):** MA 2710 or MA 2720 or MA 3710 or BUS 2100 or BA 2100



**OSM 3200 - Project Management**

Focuses on application of systems analysis to project definition and selection. Covers project teams, their structures, and interactions; cross-functional communication in technological project management; project management planning, scheduling, and control tools; project monitoring, evaluation, and termination; multiple project management and inter-project relations.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring, Summer

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

**Pre-Requisite(s):** MA 2710 or MA 2720 or MA 3710 or EET 2010 or BUS 2100 or BA 2100

**OSM 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 (ENG 2120 or MEEM 2110)

**OSM 3500 - Service Systems 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:** Spring

**Pre-Requisite(s):** OSM 3100 or BA 3610

**OSM 3730 - Systems Dynamics and Design**

Introduces principles of systems engineering as applicable to studying the behavior of engineering systems such as transportation, utility, service, construction, and project management systems. Students are introduced to Queueing Theory, Markov Chains, and System Dynamics.

**Credits:** 3.0

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

**Semesters Offered:** Spring

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

**Pre-Requisite(s):** BUS 2100(C) or BA 2100 or MA 3710(C) or MA 2720(C) or CE 2710(C) and (MA 1135 or MA 1160 or MA 1161)

**OSM 4000 - 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):** (BUS 2300 or BA 2110) and (OSM 3000 or BA 3610)

**OSM 4100 - 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 or OSM 3000

**OSM 4300 - Project Planning and Management for Engineers**

The various stages in a project life cycle will be defined and explored such as planning, metrics, execution, completion, and maintenance. Basic tools such as CPM, PERT, Gantt, and budgeting will be introduced. Change assimilation in the context of project management will also be discussed. Not open to students with credit in OSM 3200 or BA3620.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** BUS 2100 or BA 2100 or MA 2720 or MA 3710

**OSM 4750 - Risk Analysis and Management**

Fundamentals methods in analyzing and mitigating risks involved in services that function at the interface of human, natural and engineered systems. Relevant systems include transportation, service, utility, emergency and hazard management, and project management.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Restrictions:** Must be enrolled in one of the following Class(es): Senior

**Pre-Requisite(s):** OSM 3730 or CE 3730 or SSE 3730 or OSM 2300

**OSM 4760 - Optimization Methods in Decision Making**

Decision analysis and optimization techniques, including linear programming, nonlinear programming, and dynamic programming. Computer-based solutions of design problems in various engineering specialty areas are considered.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Restrictions:** Must be enrolled in one of the following Class(es): Senior

**Pre-Requisite(s):** MA 2160 and (MA 2320 or MA 2321 or MA 2330)

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**Physical Education****PE 0101 - Flag Football**

Fundamental skills and rules will be learned for co-recreational play of flag football. May be used once as a general education co-curricular course.

**Credits:** 0.5; Graded Pass/Fail Only

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

**Semesters Offered:** Fall, Summer

**PE 0103 - Bait and Fly Casting**

Bait and fly casting skills. Each student must have a valid current year Michigan fishing license. Trout stamp is optional. Equipment is available if needed. Requires some additional hours outside of class. May be use once as a general education co-curricular course.

**Credits:** 0.5; Graded Pass/Fail Only

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

**Semesters Offered:** Fall, Spring

**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 sweatsuits (with long sleeves) or white martial arts uniform. May be used once as a general education co-curricular course.

**Credits:** 0.5; Graded Pass/Fail Only

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

**Semesters Offered:** Fall, Spring

**PE 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 0114 - Frisbockey**

Fundamental skills, rules and play of frisbockey will be taught. Class is physically strenuous. May be used once as a general education co-curricular course.

**Credits:** 0.5; Graded Pass/Fail Only

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

**Semesters Offered:** Fall, Spring

**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

**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, Summer

**PE 0123 - Telemark Skiing**

The beginning skills of Telemark skiing techniques will be taught, evaluated and recommendations made for improvement. Students must provide own transportation and Telemark ski equipment. 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 Soccer**

Fundamental skills, techniques, terminology, and rules of soccer. May be used once as a general education co-curricular course.

**Credits:** 0.5; Graded Pass/Fail Only

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

**Semesters Offered:** Fall, Summer

**PE 0135 - Beginning Cross Country Skiing**

Develop the skills for touring/recreational cross-country skiing. Own equipment is recommended; rental equipment available. May be used once as a general education co-curricular course.

**Credits:** 0.5; Graded Pass/Fail Only

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

**Semesters Offered:** Spring

**PE 0137 - Table Tennis**

Fundamental skills of table tennis will be taught. May be used once as a general education co-curricular course.

**Credits:** 0.5; Graded Pass/Fail Only

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

**Semesters Offered:** Fall, Spring

**PE 0138 - Beginning Racquetball/Squash**

Fundamentals, rules, and basic strategies of racquetball/squash. Gives students opportunity to play singles, cutthroat, and doubles. Racquets, balls, and eyewear provided. Recommend use of personal racquet. May be used once as a general education co-curricular course.

**Credits:** 0.5; Graded Pass/Fail Only

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

**Semesters Offered:** Fall, Spring

**PE 0139 - Beginning Badminton**

Fundamental skills, rules, and scoring of badminton. May be used once as a general education co-curricular course.

**Credits:** 0.5; Graded Pass/Fail Only

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

**Semesters Offered:** Fall, Spring

**PE 0140 - Beginning Tennis**

Fundamentals of the game, rules, and etiquette of tennis. Meets at Gates Tennis Center. Non-marking court shoes must be worn. Tennis balls and 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 0145 - Beginning Rifle**

Using precision air rifles, beginners develop an awareness of firearms safety and marksmanship. May be used once as a general education co-curricular course.

**Credits:** 0.5; Graded Pass/Fail Only

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

**Semesters Offered:** Fall, Spring

**PE 0146 - Beginning Billiards**

Introduction to the etiquette, rules, and recreational value of pocket billiards. May be used once as a general education co-curricular course.

**Credits:** 0.5; Graded Pass/Fail Only

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

**Semesters Offered:** Fall, Spring

**PE 0148 - Beginning Skating**

Fundamental skills of ice skating, including proper stroking forward and backward, edges, crossovers, stops, and other basic skills. Requires own skates. May be used once as a general education co-curricular course.

**Credits:** 0.5; Graded Pass/Fail Only

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

**Semesters Offered:** Fall, Spring

**PE 0150 - Outdoor Lifetime Activities**

This class will introduce students to a variety of recreational activities often used in a social/leisure setting (i.e. ladder golf, disc golf, croquet, etc.). May be used once as a general education co-curricular course.

**Credits:** 0.5; Graded Pass/Fail Only

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

**Semesters Offered:** Fall, Spring

**PE 0151 - Indoor Lifetime Activities**

This class will introduce students to a variety of recreational activities often used in a social/leisure setting (i.e., shuffleboard, billiards, table tennis, etc.). May be used once as a general education co-curricular course.

**Credits:** 0.5; Graded Pass/Fail Only

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

**Semesters Offered:** Spring

**PE 0152 - 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 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**

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, 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 0165 - 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. Course is taught at the Keweenaw Fitness Center on Sharon Avenue in Houghton.

**Credits:** 0.5; Graded Pass/Fail Only

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

**Semesters Offered:** Fall, Spring

**PE 0166 - Moving for Fitness**

Introductory course to using the Student Development Complex and surrounding outdoor facilities in a variety of group and individual activities. Basic movement at your own level. May be used once as a general education co-curricular course.

**Credits:** 0.5; Graded Pass/Fail Only

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

**Semesters Offered:** 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 Keweenaw Fitness Center on Sharon Avenue in Houghton.

**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 TaeKwonDo 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:** Spring

**PE 0175 - Hiking**

Fundamental knowledge and skills specific to hiking will be covered.

Appropriate clothing and footwear for hiking is recommended. Course meets on weekends (usually Saturdays). May be use 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 0201 - Fitness Foundations II**

Full semester course set up in blocks of various fitness activities. Continuation of PE0200, Fitness Foundations; practices of incorporating physical activity into daily life to sustain health, body, and mind.

**Credits:** 1.0

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

**Semesters Offered:** Fall, Spring

**Pre-Requisite(s):** PE 0200

**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 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 0235 - Intermediate Cross Country Skiing**

Development of touring, recreational, and racing skills in cross country skiing. Own equipment is recommended; rental equipment available. Basic skills evaluated to ensure proper level of skiing proficiency. May be used once as a general education co-curricular course.

**Credits:** 0.5; Graded Pass/Fail Only

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

**Semesters Offered:** Spring

**PE 0237 - Intermediate Table Tennis**

Intermediate/advanced skills of table tennis will be taught. May be used once as a general education co-curricular course.

**Credits:** 0.5; Graded Pass/Fail Only

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

**Semesters Offered:** Fall, Spring

**PE 0238 - Intermediate Racquetball/Squash**

Reviews the fundamentals and instructs the students on the intermediate/advanced skills of racquetball and squash. Gives all students the opportunity to play singles, cutthroat, and doubles. Racquets, balls, and 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 techniques, skills, and strategies in billiards. May be used once as a general education co-curricular course.

**Credits:** 0.5; Graded Pass/Fail Only

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

**Semesters Offered:** Fall, Spring

**PE 0248 - Intermediate Skating**

Intermediate/advanced skills, including three turns, mohawk turns, jumps and spins, and drills for stops, starts, and power skating. Requires own skates. 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 2030 - Varsity Hockey**

Selective collegiate-level sports participation requiring an elite level of skill and extensive time commitment. May be used once as a general education co-curricular course.

**Credits:** 1.0; Graded Pass/Fail Only

**Lec-Rec-Lab:** (0-0-5)

**Semesters Offered:** Fall, Spring

**Restrictions:** Permission of department required

**PE 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; Graded Pass/Fail Only

**Lec-Rec-Lab:** (0-0-5)

**Semesters Offered:** Spring

**Restrictions:** Permission of department required

**PE 2050 - Varsity Soccer**

Selective collegiate-level sports participation requiring an elite level of skill and extensive time commitment. May be used once as a general education co-curricular course.

**Credits:** 1.0; Graded Pass/Fail Only

**Lec-Rec-Lab:** (0-0-5)

**Semesters Offered:** Fall, Spring

**Restrictions:** Permission of department required

**PE 2080 - Varsity Track**

Selective collegiate-level sports participation requiring an elite level of skill and extensive time commitment. May be used once as a general education co-curricular course.

**Credits:** 1.0; Graded Pass/Fail Only

**Lec-Rec-Lab:** (0-0-5)

**Semesters Offered:** Spring

**Restrictions:** Permission of department required

**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; Graded Pass/Fail Only

**Lec-Rec-Lab:** (0-0-5)

**Semesters Offered:** Fall, Spring

**Restrictions:** Permission of department required

**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; Graded Pass/Fail Only

**Lec-Rec-Lab:** (0-0-5)

**Semesters Offered:** Fall

**Restrictions:** Permission of department required

**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; Graded Pass/Fail Only

**Lec-Rec-Lab:** (0-0-5)

**Semesters Offered:** Fall

**Restrictions:** Permission of department required

**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; Graded Pass/Fail Only

**Lec-Rec-Lab:** (0-0-5)

**Semesters Offered:** Fall, Spring

**Restrictions:** Permission of department required

**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; Graded Pass/Fail Only

**Lec-Rec-Lab:** (0-0-5)

**Semesters Offered:** Fall, Spring

**Restrictions:** Permission of department required

**PE 2240 - Cheer Team**

A 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 course.

**Credits:** 1.0; Graded Pass/Fail Only

**Lec-Rec-Lab:** (0-0-5)

**Semesters Offered:** Fall, Spring

**Restrictions:** Permission of department required

**Physics****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

**Semesters Offered:** Fall, Spring

**Restrictions:** Permission of instructor required

**PH 0020 - 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 1090 - The Physics Behind Music**

Physics concepts and methods associated with musical instruments, musical recording, and musical acoustics are discussed at an introductory level. Topics include periodic motion, normal modes and resonance, superposition and Fourier series, waves, sound and acoustics, magnetism and electromagnetic induction, and topics from non-linear physics. Course is also offered online on demand in spring and summer semesters.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring, Summer

**Pre-Requisite(s):** MA 1031(C) or MA 1032(C)

**PH 1091 - The Physics Behind Music Lab**

A companion hands-on lab course covering topics from PH1090.

**Credits:** 1.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** PH 1090(C)

**PH 1100 - Physics by Inquiry I**

Experiments covering kinematics, force, conservation of momentum, conservation of energy, and waves are explored through guided construction. The course emphasizes understanding physical concepts through inquiry and the scientific method

**Credits:** 1.0

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

**Semesters Offered:** Fall, Spring, Summer

**Pre-Requisite(s):** MA 1160(C) or MA 1161(C)

**PH 1110 - College Physics I**

An overview of basic principles of kinematics, dynamics, elasticity, fluids, heat, thermodynamics, mechanical waves, and interference and diffraction of mechanical waves.

**Credits:** 3.0

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

**Semesters Offered:** Fall, 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. Intended for physics majors; highly motivated students seeking an invigorating introduction to physics may enroll with permission of the instructor.

**Credits:** 4.0

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

**Semesters Offered:** Fall

**Restrictions:** Must be enrolled in one of the following Major(s): Physics, Applied Physics

**Co-Requisite(s):** PH 1161

**Pre-Requisite(s):** MA 1160(C) or MA 1161(C)

**PH 1161 - Introduction to Experimental Physics I**

A laboratory complement to PH1160. Experiments covering kinematics, force, conservation of momentum, conservation of energy, waves and thermodynamics are explored through guided construction. The course emphasizes understanding physical concepts through inquiry and the scientific method.

**Credits:** 1.0

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

**Semesters Offered:** Fall

**Restrictions:** Must be enrolled in one of the following Major(s): Physics, Applied Physics

**Co-Requisite(s):** PH 1160

**PH 1200 - Physics by Inquiry II**

Experiments covering Coulomb's law, electric and magnetic fields, circuits, induction, and geometric optics are explored through guided construction. The course emphasizes understanding physical concepts through inquiry and the scientific method.

**Credits:** 1.0

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

**Semesters Offered:** Fall, Spring, Summer

**Pre-Requisite(s):** PH 1100 or PH 1111 or PH 1141 or PH 1161

**PH 1210 - College Physics II**

An overview of basic principles of static and dynamic electricity and magnetism, electromagnetic waves, reflection and refraction of light, interference and diffraction of light, special theory of relativity, wave theory of matter, particle theory of electromagnetic waves, theory of the atom, the nucleus, and elementary particles.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring, Summer

**Restrictions:** May not be enrolled in one of the following College(s): School of Technology, College of Engineering; May not be enrolled in one of the following Major(s): Physics, Applied Physics

**Pre-Requisite(s):** PH 1200(C) and PH 1110

**PH 1240 - Applied College Physics II**

An overview of static and dynamic electricity and magnetism, electromagnetic waves, basic optics, and an introduction to modern and nuclear physics with an emphasis on problem solving and applications.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Restrictions:** Must be enrolled in one of the following College(s): School of Technology

**Co-Requisite(s):** PH 1200

**Pre-Requisite(s):** PH 1140 or PH 1110

**PH 1360 - Honors Physics II - Rotation and Vibration**

Continuation of PH 1160. Topics include rotational motion, simple harmonic motion and mechanical waves. Offered first half of spring semester.

**Credits:** 2.0

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

**Semesters Offered:** Spring

**Co-Requisite(s):** PH 1361

**Pre-Requisite(s):** (PH 1160 or PH 2100) and MA 2160(C)

**PH 1361 - Introductory Experimental Physics II**

Laboratory complement to PH 1360. Waves, thermodynamics, and electrostatics are explored through guided construction. The course emphasizes understanding physical concepts through inquiry and the scientific method.

**Credits:** 1.0

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

**Semesters Offered:** Spring

**Co-Requisite(s):** PH 1360

**PH 1600 - Introductory Astronomy**

Introduces fundamentals of astronomy. Topics include Kepler's and Newton's laws of motion, origin and evolution of the solar system, galactic astronomy, extra-galactic astronomy, cosmology, and modern instrumentation, including space-based astronomy.

**Credits:** 2.0

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

**Semesters Offered:** Fall, Spring, Summer

**PH 1610 - Introductory Astronomy Lab**

Demonstrates fundamentals of astronomy using non-telescopic and telescopic observations, and computer simulations. Topics include angular size measurements, season-dependent measurements, phases of the moon, phases and orbits of planets, brightness of stars, introduction to the use of MTU's Observatory, instrumentation, and applications of computer programs involving cosmology.

**Credits:** 1.0

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

**Semesters Offered:** Fall

**Co-Requisite(s):** PH 1600

**PH 2020 - Introduction to Error Analysis and Scientific Programming**

An introduction to error analysis and scientific programming. Students will develop the skills needed to reduce and analyze data acquired in upper level physics labs (e.g. PH3480). Examples include error propagation and computer aided curve fitting.

**Credits:** 1.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** PH 1160 or PH 2100

**PH 2100 - University Physics I-Mechanics**

A calculus-based introduction to classical mechanics. Topics include kinematics, Newton's laws, impulse and momentum, work and energy, and the universal law of gravitation.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring, Summer

**Pre-Requisite(s):** PH 1100(C) and (MA 1160 or MA 1161 or MA 1135) and MA 2160(C)

**PH 2200 - University Physics II-Electricity and Magnetism**

A calculus-based introduction to electromagnetism. Topics include Coulomb's law, electric fields, Gauss's law, electric potential, capacitance, circuits, magnetic forces and fields, Ampere's law, induction, Maxwell's equations, and electromagnetic waves.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring, Summer

**Pre-Requisite(s):** (PH 1200(C) or PH 2261(C)) and (PH 2100 or PH 1160) and MA 2160

**PH 2230 - Electronics for Scientists**

An introduction to analog and digital electronics with an emphasis on their use in the laboratory. Topics include linear devices and basic linear circuit analysis; diodes; transistors; op-amps; the use of digital components, including logic gates, flip-flops, counters, clocks and microcontrollers, and analog to digital conversions.

**Credits:** 4.0

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

**Semesters Offered:** Spring

**Restrictions:** May not be enrolled in one of the following Major(s): Electrical Engineering, Computer Engineering

**Pre-Requisite(s):** PH 2200 or PH 2260

**PH 2260 - Honors Physics III - Electricity and Magnetism**

Calculus-based introduction to electromagnetism. Topics include Coulomb's law, electric fields, Gauss's law, electric potential, capacitance, circuits, magnetic forces and fields, Ampere's law, induction, Maxwell's equations, electromagnetic waves and geometrical optics.

**Credits:** 4.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** (PH 1160 or PH 2100) and (PH 1200(C) or PH 2261(C)) and MA 2160

**PH 2261 - Introduction to Experimental Physics III**

A laboratory complement to PH2260. Experiments covering Coulomb's law, electric and magnetic fields, circuits, induction, geometric optics, and modern physics are explored through guided construction. The course emphasizes understanding physical concepts through inquiry and the scientific method.

**Credits:** 1.0

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

**Semesters Offered:** Fall

**Co-Requisite(s):** PH 2260

**Pre-Requisite(s):** PH 1100 or PH 1161

**PH 2300 - University Physics III-Fluids and Thermodynamics**

A calculus-based introduction to fluids and thermal physics. Topics include fluid motion, propagation of heat and sound, temperature and the kinetic theory of gases, heat capacity and latent heat, first law of thermodynamics, heat engines and the second law, entropy, and an introduction to statistical mechanics. Offered second half of spring semester.

**Credits:** 2.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** PH 1160 or PH 2100

**PH 2400 - University Physics IV-Waves and Modern Physics**

A calculus-based introduction to waves and modern physics. Topics include interference and diffraction, special relativity, photons and matter waves, the Bohr atom, wave mechanics, atomic physics, molecular and solid-state physics, and nuclear physics.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring

**Pre-Requisite(s):** PH 2200 or PH 2260

**PH 3110 - Theoretical Mechanics I**

An intermediate study of mechanics, including the study of relativistic mechanics, kinematics, Newtonian mechanics of a single particle, oscillations, motion in noninertial reference frames, and gravitation and central-force motion.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** (PH 2200 or PH 2260) and (MA 3520 or MA 3521 or MA 3530 or MA 3560)

**PH 3111 - Theoretical Mechanics II**

A continuation of PH3110. Includes the study of the dynamics of a system of particles, rigid body motion, Lagrangian and Hamiltonian mechanics, coupled oscillations, and continuous systems.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** PH 3110

**PH 3210 - Optics**

An introduction to geometrical and physical optics. Topics in geometrical optics include ray analysis of mirrors, lenses, prisms, and optical systems. Topics in physical optics include polarization, interference, interferometry, and diffraction. The laboratory explores optics through experiments in imaging, fiber optics, interferometry, diffraction, polarization, and laser beam propagation.

**Credits:** 3.0

**Lec-Rec-Lab:** (2-0-3)

**Semesters Offered:** Fall

**Pre-Requisite(s):** PH 2400 and (MA 3520 or MA 3521 or MA 3530(C) or MA 3560)

**PH 3300 - Thermodynamics and Statistical Mechanics**

Thermodynamic systems, heat, work, laws of thermodynamics, formal mathematical relations, cycles, phase equilibrium, and multicomponent systems. Elementary kinetic theory. Introduction to microscopic view of entropy, ensemble theory, and applications of statistical mechanics.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** PH 2300 or PH 1360

**PH 3320 - Methods of Theoretical Physics**

Introduction to the techniques and methods frequently encountered in advanced physics with a particular emphasis on application to physical problems. Topics include, but are not limited to, complex numbers, vector analysis, partial differential equations, and integral transforms.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** MA 3160 and (MA 3520 or MA 3521 or MA 3530 or MA 3560)

**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 and PH 3210

**PH 4010 - Senior Physics Colloquium I**

Class discussion of the literature in the field of physics. Requires oral and written presentations.

**Credits:** 1.0

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

**Semesters Offered:** Fall

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

**Co-Requisite(s):** PH 4080

**PH 4011 - Senior Physics Colloquium II**

A continuation of PH4011. Class discussion of current literature and recent advances in physics. Requires oral and written presentations.

**Credits:** 1.0

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

**Semesters Offered:** Spring

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

**Co-Requisite(s):** PH 4081

**Pre-Requisite(s):** PH 4010

**PH 4050 - Qualitative Methods in Physics**

General methods and approaches of the physicist, including modeling, scaling, numerical estimation, and dimensional analysis as applied to the development, understanding, and solution of physics problems. Serves as an excellent preparation for students taking the GRE Subject Test in physics.

**Credits:** 1.0; Graded Pass/Fail Only

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

**Semesters Offered:** Fall

**Restrictions:** Must be enrolled in one of the following Major(s): Physics, Applied Physics; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

**PH 4080 - Senior Research I**

Introduction to research under the guidance of a faculty member. In addition, creative problem solving will be assessed via a student-initiated project.

**Credits:** 3.0

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

**Semesters Offered:** Fall

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

**Co-Requisite(s):** PH 4010

**Pre-Requisite(s):** PH 3480

**PH 4081 - Senior Research II**

Continuation of research under the guidance of a faculty member, culminating in a written report and presentation of results at an undergraduate research forum.

**Credits:** 3.0

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

**Semesters Offered:** Spring

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

**Co-Requisite(s):** PH 4011

**Pre-Requisite(s):** PH 4080

**PH 4090 - Senior Thesis**

Students prepare an in-depth written thesis on an approved topic in physics. Normally taken the last semester before graduation in conjunction with PH4081.

**Credits:** 1.0

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

**Semesters Offered:** Spring

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

**PH 4210 - Electricity and Magnetism I**

Intermediate study of the basic theory of electricity and magnetism, including a detailed study of electrostatic field theory and an introduction to magnetostatics.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** (PH 2200 or PH 2260) and PH 3110 and (MA 3520 or MA 3521 or MA 3530 or MA 3560)

**PH 4211 - Electricity and Magnetism II**

A continuation of PH4210. Intermediate study of magnetostatics, electrostatics, and electromagnetic waves.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** PH 4210

**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:** 2.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** PH 2020 and PH 3410

**PH 4395 - Computer Simulation in Physics**

Role of computer simulation in physics with emphasis on methodologies, data and error analysis, approximations, and potential pitfalls. Methodologies may include Monte Carlo simulation, molecular dynamics, and first-principles calculations for materials, astrophysics simulation, and biophysics simulations.

**Credits:** 3.0

**Lec-Rec-Lab:** (1-0-4)

**Semesters Offered:** On Demand

**Pre-Requisite(s):** PH 3300 and PH 4390 and (PH 2400 or 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 2400 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**

Introduction 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 4710 - Methods of Teaching Physics**

Hands-on exploration of physics education methods in classroom, laboratory, and tutoring environments. Students study highlights of physics education research and explore use of several tools and pedagogical techniques, including web-based homework systems, simulations, classroom feedback systems, and equipment for laboratories and lecture demonstrations.

**Credits:** 2.0

**Lec-Rec-Lab:** (0-1-2)

**Semesters Offered:** Spring - Offered alternate years beginning with the 2010-2011 academic year

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

**Pre-Requisite(s):** PH 1210 or PH 2200 or PH 2260

**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

**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

**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

**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:** On Demand

**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:** On Demand

**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 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:** (0-3-1)

**Semesters Offered:** Spring

**Restrictions:** Must be enrolled in one of the following Major(s): Social Sciences, Psychology

**Pre-Requisite(s):** MA 1020 or MA 1031 or MA 1032 or MA 1160(C) or MA 1161(C)

**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

**Restrictions:** Must be enrolled in one of the following Major(s): Psychology;

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

**Pre-Requisite(s):** PSY 2000 and (MA 2720 or PSY 2720)

**PSY 3001 - Experimental Methods and Statistics II**

Second course in psychological research methodology and statistics, both experimental and non-experimental. Students design, execute, interpret, and report psychological research.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**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

**Pre-Requisite(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-Requisite(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:** Fall, Spring

**Pre-Requisite(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-Requisite(s):** PSY 2000

**PSY 3090 - Directed Research: Undergraduate Research Assistant in Psychology**

Directed research in the field of Psychology through the application of research techniques.

**Credits:** variable to 3.0; May be repeated

**Semesters Offered:** Fall, Spring, Summer

**Restrictions:** Permission of instructor required; Must be enrolled in one of the following Major(s): Psychology; May not be enrolled in one of the following Class(es): Freshman

**Pre-Requisite(s):** PSY 2000

**PSY 3095 - Teaching Assistant**

Undergraduate Teaching Assistant for Principles of Psychology or other 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

**Pre-Requisite(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:** On Demand

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

**Pre-Requisite(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-Requisite(s):** PSY 2000

**PSY 3700 - Industrial Organizational Psychology**

The psychology of work and organizations. Introduction to the use and application of psychology in the workplace. Focus is on the development of employees and organizational structure, and social behavior including the management of work groups and organizations.

**Credits:** 3.0

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

**Semesters Offered:** On Demand

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

**Pre-Requisite(s):** PSY 2000

**PSY 3720 - Social Psychology**

Survey of social, cultural, and cognitive influences on individual and group behavior. Introduces attitude formation, social conformity, personal perception, aggression, cooperation, and interpersonal and intergroup relations.

**Credits:** 3.0

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

**Semesters Offered:** On Demand

**Pre-Requisite(s):** UN 2002 or PSY 2000

**PSY 3750 - Judgment and Decision Making**

How can we make better decisions? Using examples from medicine, politics, law, business, and daily life, we reexamine "descriptive" (psychological), "normative" (rational), and "prescriptive" (decision-engineering) theory. Topics include judgment, cognition, emotion, risk, uncertainty, optimization, heuristics, biases, morality, and applications.

**Credits:** 3.0

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

**Semesters Offered:** On Demand

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

**Pre-Requisite(s):** PSY 2720 or MA 2720

**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-Requisite(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

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

**Pre-Requisite(s):** PSY 2000

**PSY 3860 - Human Performance**

An overview of cognitive task analysis and process tracing methods used to examine human performance in complex socio-technical systems. Topics include knowledge elicitation, concept mapping, critical decision method, and protocol analysis.

**Credits:** 3.0

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

**Semesters Offered:** On Demand

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

**Pre-Requisite(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-Requisite(s):** PSY 2000

**PSY 4060 - Cognitive Neuroscience**

Topics in the field of cognitive neuroscience, examining the neural basis of cognition. Topics may include perception, attention, memory and language.

**Credits:** 3.0

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

**Semesters Offered:** On Demand

**Pre-Requisite(s):** PSY 3060

**PSY 4080 - Topics in Psychology**

An examination of a specific area or approach within the field of Psychology.

**Credits:** variable to 4.0; May be repeated

**Semesters Offered:** On Demand

**Pre-Requisite(s):** PSY 2000

**PSY 4090 - Independent Study in Psychology**

Designed to allow students to participate in independent readings or research in a variety of areas within psychology.

**Credits:** variable to 6.0; Repeatable to a Max of 9

**Semesters Offered:** On Demand

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

**Pre-Requisite(s):** PSY 2000

**PSY 4095 - Field Experience in Psychology**

Firsthand experience with the application of psychological principles in the field through volunteer placement with a community agency or business. Students are responsible for obtaining field placement site in coordination with instructor. Students complete a comprehensive paper.

**Credits:** variable to 3.0; Repeatable to a Max of 6

**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

**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:** Spring

**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 2000 and (BL 1040 or BL 1020)

**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 application to graduate programs, an intensive exploration into an area (e.g., experimental, developmental, clinical) of psychology or related field, will enhance learning and synthesize career goals in an effort to transition to an advanced educational program.

**Credits:** 1.0

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

**Semesters Offered:** Fall

**Restrictions:** Must be enrolled in one of the following Major(s): Psychology;

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

**Pre-Requisite(s):** PSY 3000(C)

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**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



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## System Administration Technology

### SAT 1200 - Introduction to Programming

Introductory course in C/C++ programming. Topics include top-down analysis of problems, structured programming, control statements, loops, and functions, arrays, and pointers. Basic concepts of object-oriented programming (classes, objects, function overloading) will also be introduced.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Restrictions:** Must be enrolled in one of the following Major(s): Industrial Technology, Computer Network & System Admn; Must be enrolled in one of the following Class(es): Freshman, Sophomore

### SAT 1610 - Computer and Operating Systems Architecture

Fundamentals of computer organization, operating system architecture, PC/WS major subassemblies, PC and server configuration planning, power interfaces, system assembly/set-up, connection of peripherals, installing fundamental operating system software, system testing/debugging and planning and installation of application software portfolios.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Restrictions:** Must be enrolled in one of the following Major(s): Computer Network & System Admn

**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, and 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 Admn

### SAT 2343 - Network Administration I

Introduction to basic networking concepts and implementation. Topics include OSI model, subnetting, network addressing, data encapsulation, network topologies, and basic configuration of networking hardware including cabling, bridges, routers, and other communications.

**Credits:** 4.0

**Lec-Rec-Lab:** (0-3-2)

**Semesters Offered:** Fall

**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 backup/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 include iSCSI, DAS, NAS, 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, Spring

**Pre-Requisite(s):** SAT 2511 and SAT 2711

### SAT 3210 - Database Management

Introductory course on database management. Topics include data modeling, database design, implementation techniques, Oracle SQL Language, database administration and security.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Summer

**Restrictions:** Must be enrolled in one of the following Major(s): Computer Network & System Admn

**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 servers, MS system tuning, remote access, and backup 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 system management, installation and maintenance, network security, data integrity, and enterprise infrastructures such as identity management, authentication, authorization and directory services.

**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 and FCC Regulations

Evolution of wireless communications, standards, and regulations. Topics include IEEE 802.11b/a/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 Admn

**Pre-Requisite(s):** SAT 3812

### SAT 4240 - Voice over IP Engineering

Voice over IP (VoIP) engineering and design. Topics include call and session protocols such as SIP, H.323, IAX and MGCP; VAD and PLC; common practical issues such as call redirection; codec integration and quality of service measurements.

**Credits:** 3.0

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

**Semesters Offered:** Spring - Offered alternate years beginning with the 2011-2012 academic year

**Restrictions:** Must be enrolled in one of the following Major(s): Computer Network & System Admn

**Pre-Requisite(s):** SAT 2511 and SAT 2711 and SAT 3343

### SAT 4310 - Advanced Scripting Programming

Emphasizes advanced portions of scripting programming, testing, implementation and documentation (i.e. PERL, PHP, Python and Shell Scripting). Other topics include language syntax data and file structures, input/output devices, file and graphical user interfaces.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Restrictions:** Must be enrolled in one of the following Major(s): Computer Network & System Admn

**Pre-Requisite(s):** SAT 1200 and SAT 2511 and SAT 2711

### SAT 4343 - Network Engineering

Topics include router and switch flow control; VoIP, compression and load balancing; VPN networks involving MPLS, IPSEC and PPP; advanced access-list configuration; AAA; Kerberos; TACACS; firewalls; and configuration of advanced routing protocols.

**Credits:** 3.0

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

**Semesters Offered:** Spring - Offered alternate years beginning with the 2010-2011 academic year

**Pre-Requisite(s):** SAT 3343



### SAT 4480 - Senior Project I

Capstone course requiring the application of knowledge gained in lower division courses. Projects are team oriented, require weekly progress reports, and culminate with a final report and oral presentation.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring, Summer

**Restrictions:** Permission of instructor required; Must be enrolled in one of the following Major(s): Computer Network & System Admn; Must be enrolled in one of the following Class(es): Junior, Senior

### SAT 4541 - Directory Services Architecture

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 concept 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 Applications and 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 Class(es): Junior, Senior

**Pre-Requisite(s):** SAT 4480

### SAT 4996 - Special Topics in Computer Network Systems Administration

Selected additional topics of interest in Computer Network Systems Administration based on student and faculty demand and interest. May be a tutorial, seminar, workshop, project, or class study.

**Credits:** variable to 3.0; Repeatable to a Max of 6

**Semesters Offered:** On Demand

**Restrictions:** Permission of instructor required; Must be enrolled in one of the following Major(s): Computer Network & System Admn; Must be enrolled in one of the following Class(es): Senior

### 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 Admn; 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 Admn; Must be enrolled in one of the following Class(es): Senior

## Social Sciences

### SS 1001 - Orientation to the Social Sciences

Introduction to departmental requirements, relevant university resources, careers in social sciences and history, skill expectations, and portfolio development; assessment of current knowledge.

**Credits:** 1.0

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

**Semesters Offered:** Fall, Spring

**Restrictions:** Must be enrolled in one of the following Major(s): Social Sciences, Liberal Arts with History Opt, Anthropology

### 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:** Spring

### 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 3110 - Food Systems**

Compares the embedded nature of culturally defined food production and consumption habits: the crux of nature meeting and mixing with culture. The course features classic food system scholarship as well as emerging topics and contemporary case studies.

**Credits:** 3.0

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

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

**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 through 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 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**

Landscape is a lens through which scholars study people, environment, and place. The concept transcends traditional disciplinary boundaries. Students will read and discuss different approaches to landscape, with special focus upon anthropological, geographic, and historical perspectives.

**Credits:** 3.0

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

**Semesters Offered:** Fall - 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 bio-anthropological principles of evolutionary change, the current fossil record evidencing human evolution, and the consequences of human evolutionary change for modern human variability, health, and behavior.

**Credits:** 3.0

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

**Semesters Offered:** Fall, 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

**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: ethnogenesis 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 3313 - Sustainability Science, Policy, and Assessment**

Foundational scientific concepts (dynamic systems and catastrophe theory) as applied to socioecological systems. Use of indicators and indices to track progress towards sustainability goals. Review of local, national, and global sustainability policies to avoid catastrophes and guide sustainable development.

**Credits:** 3.0

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

**Semesters Offered:** On Demand

**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 - Offered alternate years beginning with the 2010-2011 academic year

**Pre-Requisite(s):** UN 2002

**SS 3500 - Modern American History**

A broad survey of American history in the twentieth and twenty-first centuries.

**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, Summer

**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 - Building America: The History of Planning, Engineering, and Development in the United States**

This course surveys the landscapes and environments that Americans have designed, built, and inhabited. Students will consider how places both reflect and shape ideas, policy, technologies, and social relationships.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** UN 2002

**SS 3515 - History of American Architecture**

Survey of North American architecture from prehistoric times to the present. Focuses on principal architectural styles, building types, and construction technologies. Also examines ideas about architecture to understand the American past.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** UN 1002 or UN 1003

**SS 3520 - U.S. Environmental History**

Examines how human interaction with physical environment has changed in North America over the last four centuries. Topics include uses of land by Native Americans, changes associated with European colonization, incorporation of natural resources into industrial economy, early conservation and preservation movements, and environmental concerns accompanying urbanization and industrialization.

**Credits:** 3.0

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

**Semesters Offered:** Spring - Offered alternate years beginning with the 2000-2001 academic year

**Pre-Requisite(s):** UN 2002

**SS 3521 - Energy in American History**

Examines changes in energy use throughout American history, beginning with energy use by American Indians and Europeans during colonial settlement and continuing through fossil fuels and adoption of nuclear power. Helps students see energy in all we do.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** UN 2002

**SS 3530 - The Automobile in America**

Examines the automobile in diverse ways, seeing it as a complex product to be manufactured, as a stimulus to reshaping the environment, as an object that has altered social behavior, and as a problem solver and problem maker.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Summer

**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 2001-2002 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 3560 - 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, Summer

**Pre-Requisite(s):** UN 1002 or UN 1003

**SS 3561 - 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 - Offered alternate years beginning with the 2011-2012 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 case, and engage in a moot court.

**Credits:** 3.0

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

**Semesters Offered:** Fall - 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 Management**

Covers principles of intellectual property law, addressing managerial and policy issues in copyright, trademark, trade secret, and patents. Readings and discussions also cover how these property and legal systems impact the balance between property exclusivity, technological innovation, and public access.

**Credits:** 3.0

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

**Semesters Offered:** Fall - 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 3660 - Constitutional Law**

Introduces the U.S. Constitution and how it has been interpreted by the Supreme Court over time. Explores historical, social and political consequences of major constitutional themes such as federalism, judicial review, and evolving view of individual rights and liberties.

**Credits:** 3.0

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

**Semesters Offered:** 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 3661 - Civil Rights & Civil Liberties**

Seminar focused on the rights and liberties guaranteed by US Constitutional amendments. Students learn constitutional theory and interpretation on topics of privacy, speech, media, religion, criminal justice, and gender/ethnic equality. Constitutional Law I is not required.

**Credits:** 3.0

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

**Semesters Offered:** Fall - Offered alternate years beginning with the 2010-2011 academic year

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

**Pre-Requisite(s):** SS 1002(C) or SS 2600(C) or SS 2610 or SS 3610(C) or SS 3660(C)

**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, Summer

**Pre-Requisite(s):** UN 2002 or PSY 2000

**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 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 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 4001 - History of Social Thought**

An intensive survey of the literature of 19th-20th century history of social thought, including the writings of Marx, Durkheim, Weber, and other prominent anthropologists, sociologists, and political philosophers.

**Credits:** 3.0

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

**Semesters Offered:** Spring - Offered alternate years beginning with the 2006-2007 academic year

**Restrictions:** Must be enrolled in one of the following Class(es): Junior, Senior

**Pre-Requisite(s):** UN 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:** 3.0

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

**Semesters Offered:** Spring - Offered alternate years beginning with the 2000-2001 academic year

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

**Pre-Requisite(s):** 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:** Fall, Spring

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

**Pre-Requisite(s):** ED 4700(C)

**SS 4030 - Senior Seminar in Anthropology**

Capstone course for anthropology majors. Students examine career and graduate studies in anthropology and prepare proposal for senior research project.

**Credits:** 2.0

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

**Semesters Offered:** Fall

**Restrictions:** Must be enrolled in one of the following Class(es): Senior

**Pre-Requisite(s):** UN 2002

**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:** Spring - Offered alternate years beginning with the 2010-2011 academic year

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

**Pre-Requisite(s):** UN 1002 or UN 1003

**SS 4211 - Ethnographic Methods**

Field-based course that surveys basic concepts of ethnography and applies them in a class research project. Provides practical experience in field observation, interviews, field notes, and write-up of research.

**Credits:** 3.0

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

**Semesters Offered:** Spring - Offered alternate years beginning with the 2011-2012 academic year

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

**Pre-Requisite(s):** UN 2002

**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 4390 - Seminar in Sustainability Issues**

An intensive seminar focused on a sustainability issue or field, such as sustainable development, environmental justice, globalization, or other current and relevant topics. May be repeated if topic differs.

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

**Semesters Offered:** On Demand

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

**Pre-Requisite(s):** UN 2002

**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 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 2011-2012 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, Spring

**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:** Fall, Spring

**Restrictions:** Permission of instructor required; Must be enrolled in one of the following Class(es): Senior

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## 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 basic quality tools and service systems engineering examples.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**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):** CS 1121(C) or CS 1131(C)

**SSE 3400 - Human Interactions in Service Systems**

Service system customers and employees can benefit from user-centered design. This course explores both the psychological and physical characteristics of human beings, as well as cultural influences on their behavior. It introduces data collection methods such as surveys, focus groups, and structured interviews. It then presents how to apply human factors principles to the design process.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** PSY 2000 and (MEEM 2110 or ENG 2120)

**SSE 3500 - Service System Operations**

Focuses on the operation of service systems in a customer-focused environment. Topics will include work measurement, performance management, and process evaluation and improvement. Supply chain, demand management and lean practices will also be introduced.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** BA 3610 or OSM 3000

**SSE 3730 - Systems Dynamics and Design**

Introduces principles of systems engineering as applicable to studying the behavior of engineering systems such as transportation, utility, service, construction, and project management systems. Students are introduced to Queueing Theory, Markov Chains, and System Dynamics.

**Credits:** 3.0

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

**Semesters Offered:** Spring

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

**Pre-Requisite(s):** BUS 2100(C) or BA 2100 or MA 3710(C) or MA 2720(C) or CE 2710(C) and (MA 1135 or MA 1160 or MA 1161)

**SSE 4300 - Project Planning and Management for Engineers**

The various stages in a project life cycle will be defined and explored such as planning, metrics, execution, completion, and maintenance. Basic tools such as CPM, PERT, Gantt, and budgeting will be introduced. Change assimilation in the context of project management will also be discussed. Not open to students with credit in BA3620 or OSM3200.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Summer

**Pre-Requisite(s):** MA 2720 or MA 3710 or BA 2100 or BUS 2100

**SSE 4750 - Risk Analysis and Management**

Fundamentals methods in analyzing and mitigating risks involved in services that function at the interface of human, natural and engineered systems. Relevant systems include transportation, service, utility, emergency and hazard management, and project management.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Restrictions:** Must be enrolled in one of the following Class(es): Senior

**Pre-Requisite(s):** OSM 3730 or CE 3730 or SSE 3730 or SSE 2300

**SSE 4760 - Optimization Methods in Decision Making**

Decision analysis and optimization techniques, including linear programming, nonlinear programming, and dynamic programming. Computer-based solutions of design problems in various engineering specialty areas are considered.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Restrictions:** Must be enrolled in one of the following Class(es): Senior

**Pre-Requisite(s):** MA 2160 and (MA 2320 or MA 2321 or MA 2330)

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## Surveying

**SU 1500 - Introduction to Surveying Instruments**

Overview of historic and modern surveying instruments. Familiarization of total stations, GPS receivers, levels, 3D scanners, and data collectors.

**Credits:** 1.0

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

**Semesters Offered:** Fall

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

**SU 2000 - Introduction to Surveying**

Surveying topics will include distance measurements, leveling, angles, directions, traversing, horizontal and vertical curves, percent grade, and coordinate geometry.

**Credits:** 2.0

**Lec-Rec-Lab:** (0-1-2)

**Semesters Offered:** Fall, Spring



**SU 2050 - Plane Surveying**

An introductory course studying surveying instruments and their use in the measurement of angles, distances, and elevations. Topics include taping, leveling, traversing, construction surveys, route surveys, use of modern instrumentation, and computer applications.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** SU 2000(C)

**SU 2220 - Route and Construction Surveying**

Study of the geometry and field stake-out techniques of circular curves, spiral curves, compound curves, reverse curves, equal-tangent vertical curves, and unequal-tangent vertical curves. Other topics include horizontal and vertical alignment design, earthwork quantities and mass diagrams.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** SU 2050

**SU 2260 - Survey Computations**

Introduction to the PLSS system and cadastral management software. Mathcad software is utilized to perform survey related computations for coordinate forms, intersections, resections, conformal transformations and least squares adjustments.

**Credits:** 3.0

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

**Semesters Offered:** Spring

**Pre-Requisite(s):** SU 2050

**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 and the role of the surveyor in issuing opinions on boundary location in boundary disputes.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Restrictions:** Must be enrolled in one of the following Class(es): Junior, Senior

**Pre-Requisite(s):** SU 2260

**SU 3210 - Site Planning and Development**

An examination of land development issues including: site analysis, environmental concerns, contouring, earthwork and grading, soils, route alignments, storm water management, sewer systems, zoning, and land planning. Incorporates CAD applications in the lab.

**Credits:** 4.0

**Lec-Rec-Lab:** (0-3-2)

**Semesters Offered:** Spring

**Restrictions:** Must be enrolled in one of the following Class(es): Junior, Senior

**Pre-Requisite(s):** SU 2050

**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 principles.

**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 - Geographic Information Systems (GIS) Technology Fundamentals**

Course provides review of Geographic Information Systems applications and analysis. Includes core concepts such as data acquisition and management, topology, accuracy, metadata, output, quality control, analysis methods, new and traditional software options, web mapping, and GIS implementation/management for research and production.

**Credits:** 1.0

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

**Semesters Offered:** On Demand

**SU 4010 - Geospatial Concepts, Technologies, and Data**

High level review of geospatial data acquisition systems, sensors, and associated processing technologies. Course considers geospatial metadata generation principles, interoperability, and major tools for manipulation with geospatial data. Course may help in transition of non-geospatial majors to geospatial field.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring

**Restrictions:** Must be enrolled in one of the following Major(s): Surveying Engineering; Must be enrolled in one of the following Class(es): Senior

**Pre-Requisite(s):** SU 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 Review**

A review of all elements of the NCEES Fundamentals of Land Surveying examination, which leads to licensure as a professional land surveyor.

**Credits:** 1.0; Graded Pass/Fail Only

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

**Semesters Offered:** Fall

**Restrictions:** Must be enrolled in one of the following Class(es): Junior, Senior

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## Technology

**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 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 4470 - Senior Project**

Completion and evaluation of design projects using computer-aided engineering methods, physical models, and/or prototypes. Deliverables include evaluation and design optimization methods for efficient and cost-effective designs, oral presentation, and written final report.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Spring

**Restrictions:** Permission of instructor required; Must be enrolled in one of the following Class(es): Senior

**Pre-Requisite(s):** MET 4460

**TE 4996 - Special Topics in Technology**

Selected additional topics of interest in Technology based on student and faculty demand and interest. May be a tutorial, seminar, workshop, project, or class study.

**Credits:** variable to 3.0; Repeatable to a Max of 6

**Semesters Offered:** On Demand

**Restrictions:** Permission of instructor required; Must be enrolled in one of the following College(s): School of Technology; Must be enrolled in one of the following Class(es): Senior

**TE 4997 - Independent Study in Technology**

Independent study of an approved topic under the guidance of a School of Technology faculty member. May be either an academic, design, or research problem/project.

**Credits:** variable to 3.0; Repeatable to a Max of 6

**Semesters Offered:** On Demand

**Restrictions:** Permission of instructor required; Must be enrolled in one of the following College(s): School of Technology; Must be enrolled in one of the following Class(es): Senior

**TE 4998 - Undergraduate Research in Technology**

An undergraduate research experience in Technology. Under the guidance of a School of Technology faculty member, students work on a selected/approved research problem or work directly with faculty on active research projects/grants. May require more than one semester to complete.

**Credits:** variable to 6.0; Repeatable to a Max of 6

**Semesters Offered:** On Demand

**Restrictions:** Permission of instructor required; Must be enrolled in one of the following College(s): School of Technology; Must be enrolled in one of the following Class(es): Senior

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## University Wide

**UN 0500 - Effective Scholarship**

Course meets federal requirements for responsible conduct of research training for graduate students. Course includes oral and written communication practice as well as opportunities to learn techniques for being successful in graduate school. Students who pass the course will be awarded a certificate of completion.

**Credits:** 1.0; Graded Pass/Fail Only

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

**Semesters Offered:** On Demand

**Restrictions:** Must be enrolled in one of the following Level(s): Graduate

**UN 1000 - Frameworks for Success**

An introduction to University life, exploring ways to become a more effective student focusing on personal and professional habits necessary for success. Topics include academic skill development, time management, and university resources.

**Credits:** 1.0

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

**Semesters Offered:** Fall, Summer

**UN 1001 - 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

**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 - Composition: Oral, Written, and Visual**

Provides advanced, direct instruction in composition. Students examine and interpret communication practices and apply what they learn to their own written, spoken, and visual work. Class projects ask students to communicate in a variety of modes and to attend to audience, purpose and context.

**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 - Leading and Working in Teams**

Course designed for students in the Pavlis program, to develop group problem-solving skills. Stresses interpersonal skills and skill assessment, communication, group process and teamwork, and action planning. Uses active hands-on learning.

**Credits:** 1.0

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

**Semesters Offered:** 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

**Semesters Offered:** Fall, Spring, Summer

**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

**Pre-Requisite(s):** UN 2100

**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 3100

**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

**Co-Requisite(s):** UN 3405, UN 3406

**Pre-Requisite(s):** UN 3200

**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

**Co-Requisite(s):** UN 3404, UN 3406

**Pre-Requisite(s):** UN 3200

**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

**Co-Requisite(s):** UN 3404, UN 3405

**Pre-Requisite(s):** UN 3200

**UN 3995H - Honors Institute Contract**

**Credits:** 0.0; Graded Pass/Fail Only

**Semesters Offered:** On Demand

**UN 4000 - Remote Sensing Seminar**

A seminal series that covers topical issues in remote sensing, ecosystem research, and global change. Required for all students with a minor in remote sensing.

**Credits:** 1.0; Repeatable to a Max of 2

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

**Semesters Offered:** Fall, Spring

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

**UN 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

**Semesters Offered:** On Demand

**Restrictions:** Permission of instructor required

**UN 4995H - Honors Institute Contract**

**Credits:** 0.0; Graded Pass/Fail Only

**Semesters Offered:** On Demand

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Email: [registrar@mtu.edu](mailto:registrar@mtu.edu)  
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Fax: (906) 487-3343  
[Webmaster](#)

**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, Summer

**Pre-Requisite(s):** UN 2002 or PSY 2000

**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:** On Demand

**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 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 4001 - History of Social Thought**

An intensive survey of the literature of 19th-20th century history of social thought, including the writings of Marx, Durkheim, Weber, and other prominent anthropologists, sociologists, and political philosophers.

**Credits:** 3.0

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

**Semesters Offered:** Spring - Offered alternate years beginning with the 2006-2007 academic year

**Restrictions:** Must be enrolled in one of the following Class(es): Junior, Senior

**Pre-Requisite(s):** UN 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:** 3.0

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

**Semesters Offered:** Spring - Offered alternate years beginning with the 2000-2001 academic year

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

**Pre-Requisite(s):** 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, Sophomore, Junior

**Pre-Requisite(s):** ED 4700(C)

**SS 4030 - Senior Seminar in Anthropology**

Capstone course for anthropology majors. Students examine career and graduate studies in anthropology and prepare proposal for senior research project.

**Credits:** 2.0

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

**Semesters Offered:** Fall

**Restrictions:** Must be enrolled in one of the following Class(es): Senior

**Pre-Requisite(s):** UN 2002

**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 4211 - Ethnographic Methods**

Field-based course that surveys basic concepts of ethnography and applies them in a class research project. Provides practical experience in field observation, interviews, field notes, and write-up of research.

**Credits:** 3.0

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

**Semesters Offered:** Spring - Offered alternate years beginning with the 2011-2012 academic year

**Restrictions:** May not be enrolled in one of the following Class(es):

Freshman, Sophomore

**Pre-Requisite(s):** UN 2002

**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 4390 - Seminar in Sustainability Issues**

An intensive seminar focused on a sustainability issue or field, such as sustainable development, environmental justice, globalization, or other current and relevant topics. May be repeated if topic differs.

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

**Semesters Offered:** On Demand

**Restrictions:** May not be enrolled in one of the following Class(es):

Freshman, Sophomore

**Pre-Requisite(s):** UN 2002

**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 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 2011-2012 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:** Fall, Spring

**Restrictions:** Permission of instructor required; Must be enrolled in one of the following Class(es): Senior 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) and MA 1135 or MA 1160 or MA 1161)

**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):** CS 1121(C) or CS 1131(C)

**SSE 3400 - Human Interactions in Service Systems**

Service system customers and employees can benefit from user-centered design. This course explores both the psychological and physical characteristics of human beings, as well as cultural influences on their behavior. It introduces data collection methods such as surveys, focus groups, and structured interviews. It then presents how to apply human factors principles to the design process.

**Credits:** 3.0

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

**Semesters Offered:** Fall

**Pre-Requisite(s):** PSY 2000

**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:** Spring

**Pre-Requisite(s):** BA 3610

**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, Gantt, and budgeting will be introduced. Change assimilation in the context of project management will also be discussed. Not open to students with credit in BA3620.

**Credits:** 3.0

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

**Semesters Offered:** Fall, Summer

**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 1135 or MA 1160 or MA 1161 and MA 2720(C)) or MA 3710(C)

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**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

**Restrictions:** Must be enrolled in one of the following Major(s): Surveying Engineering

**SU 2000 - Introduction to Surveying**

Surveying topics will include distance measurements, leveling, angles, directions, traversing, horizontal and vertical curves, percent grade, and coordinate geometry.

**Credits:** 2.0

**Lec-Rec-Lab:** (0-1-2)

**Semesters Offered:** Fall, Spring

**SU 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 geometry and field stake-out techniques of circular curves, spiral curves, compound curves, reverse curves, equal-tangent vertical curves, and unequal-tangent vertical curves. Other topics include horizontal and vertical alignment design, earthwork quantities and mass diagrams.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-3-0)

**Semesters Offered:** Spring

**Pre-Requisite(s):** SU 2000 or SU 2150

**SU 2260 - Survey Computations**

Introduction to the PLSS system and cadastral management software. Mathcad software is utilized to perform survey related computations for coordinate forms, intersections, resections, conformal transformations and least squares adjustments.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-3-0)

**Semesters Offered:** Spring

**Pre-Requisite(s):** SU 2000 or SU 2150

**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 and the role of the surveyor in issuing opinions on boundary location in boundary disputes.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-3-0)

**Semesters Offered:** Fall

**Restrictions:** Must 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 principles.

**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 - Geographic Information Systems (GIS) Technology Fundamentals**

Course provides review of Geographic Information Systems applications and analysis. Includes core concepts such as data acquisition and management, topology, accuracy, metadata, output, quality control, analysis methods, new and traditional software options, web mapping, and GIS implementation/management for research and production.

**Credits:** 1.0

**Lec-Rec-Lab:** (1-0-0)

**Semesters Offered:** On Demand

**SU 4010 - Geospatial Concepts, Technologies, and Data**

High level review of geospatial data acquisition systems, sensors, and associated processing technologies. Course considers geospatial metadata generation principles, interoperability, and major tools for manipulation with geospatial data. Course may help in transition of non-geospatial majors to geospatial field.

**Credits:** 3.0

**Lec-Rec-Lab:** (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:** (0-3-0)

**Semesters Offered:** Fall, Spring

**Restrictions:** Must be enrolled in one of the following Major(s): Surveying

Engineering; Must be enrolled in one of the following Class(es): Senior

**Pre-Requisite(s):** SU 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 Review**

A review of all elements of the NCEES Fundamentals of Land Surveying examination, which leads to licensure as a professional land surveyor.

**Credits:** 1.0; Graded Pass/Fail Only

**Lec-Rec-Lab:** (0-1-0)

**Semesters Offered:** Fall

**Restrictions:** Must be enrolled in one of the following Class(es): Junior, Senior

## Technology

**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 3600 - 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 4470 - Senior Project**

Completion and evaluation of design projects using computer-aided engineering methods, physical models, and/or prototypes. Deliverables include evaluation and design optimization methods for efficient and cost-effective designs, oral presentation, and written final report.

**Credits:** 3.0

**Lec-Rec-Lab:** (0-0-6)

**Semesters Offered:** Fall, Spring

**Restrictions:** Permission of instructor required; Must be enrolled in one of the following Class(es): Senior

**Pre-Requisite(s):** MET 4460

**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 4996 - Special Topics in Technology**

Selected additional topics of interest in Technology based on student and faculty demand and interest. May be a tutorial, seminar, workshop, project, or class study.

**Credits:** variable to 3.0; Repeatable to a Max of 6

**Semesters Offered:** On Demand

**Restrictions:** Permission of instructor required; Must be enrolled in one of the following College(s): School of Technology; Must be enrolled in one of the following Class(es): Senior

**TE 4997 - Independent Study in Technology**

Independent study of an approved topic under the guidance of a School of Technology faculty member. May be either an academic, design, or research problem/project.

**Credits:** variable to 3.0; Repeatable to a Max of 6

**Semesters Offered:** On Demand

**Restrictions:** Permission of instructor required; Must be enrolled in one of the following College(s): School of Technology; Must be enrolled in one of the following Class(es): Senior

**TE 4998 - Undergraduate Research in Technology**

An undergraduate research experience in Technology. Under the guidance of a School of Technology faculty member, students work on a selected/approved research problem or work directly with faculty on active research projects/grants. May require more than one semester to complete.

**Credits:** variable to 6.0; Repeatable to a Max of 6

**Semesters Offered:** On Demand

**Restrictions:** Permission of instructor required; Must be enrolled in one of the following College(s): School of Technology; Must be enrolled in one of the following Class(es): Senior

## University Wide

**UN 1000 - Frameworks for Success**

An introduction to University life, exploring ways to become a more effective student focusing on personal and professional habits necessary for success. Topics include academic skill development, time management, and university resources.

**Credits:** 1.0

**Lec-Rec-Lab:** (0-0-2)

**Semesters Offered:** Fall, Summer

**UN 1001 - 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

**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 - Composition: Oral, Written, and Visual**

Provides advanced, direct instruction in composition. Students examine and interpret communication practices and apply what they learn to their own written, spoken, and visual work. Class projects ask students to communicate in a variety of modes and to attend to audience, purpose and context.

**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

**Semesters Offered:** Fall, Spring, Summer

**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

**Pre-Requisite(s):** UN 2100

**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 3100

**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

**Co-Requisite(s):** UN 3405, UN 3406

**Pre-Requisite(s):** UN 3200

**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

**Co-Requisite(s):** UN 3404, UN 3406

**Pre-Requisite(s):** UN 3200



**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

**Co-Requisite(s):** UN 3404, UN 3405

**Pre-Requisite(s):** UN 3200

UN 3995H - Honors Institute Contract

**Credits:** 0.0; Graded Pass/Fail Only

**Semesters Offered:** On Demand

**UN 4000 - Remote Sensing Seminar**

A seminal series that covers topical issues in remote sensing, ecosystem research, and global change. Required for all students with a minor in remote sensing.

**Credits:** 1.0; Repeatable to a Max of 2

**Lec-Rec-Lab:** (0-1-0)

**Semesters Offered:** Fall, Spring

**Restrictions:** May not be enrolled in one of the following Class(es):

Freshman, Sophomore

**UN 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

**Semesters Offered:** On Demand

**Restrictions:** Permission of instructor required

UN 4995H - Honors Institute Contract

**Credits:** 0.0; Graded Pass/Fail Only

**Semesters Offered:** On Demand

# 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/](http://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.

Time of Withdrawal	Refund Percentage
Through Wednesday of the first week	100%
Thursday and Friday of 1st week	90%
2nd week	80%
3rd week	70%
4th week	60%
5th week	50%
6th week	40%

**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

Federal financial aid regulations require students to make satisfactory progress to remain eligible for financial aid. Financial aid programs affected by this policy include Federal Pell Grants, Federal Perkins Loans, Federal and Michigan Work-Study, Federal and Michigan Educational Opportunity Grants, Federal Direct Subsidized Loans, Federal Direct Unsubsidized Loans, Federal PLUS Loans, Michigan Competitive Scholarships, the Michigan Adult Part-time Grants, Michigan Tuition Incentive Program, Academic Competitive Grants, and the National Science and Mathematics Access to Retain Talent (SMART) Grants.

**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

Full-Time Semesters at Michigan Tech	Undergraduate Student	MS Student	PhD Student
1	9	4	4
1.5*	13	6	6
2	18	8	8
3	28	12	12
4	38	16	16
5	49	20	20
6	60	24	24
7	71	28	28
8	82	32	32
More than 8	—	no aid	—
9	94	no aid	36
10	106	—	40
11	118	—	44
12	130	—	48
More than 12	no aid	—	—
13	—	—	52
14	—	—	56
More than 14	—	—	no aid

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### 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 ( $60 \text{ credits} / 15 = 4 \text{ semesters}$ ). The student in this example would have 8 full-time semesters of eligibility remaining ( $12 \text{ semesters maximum} - 4 \text{ calculated transfer semesters} = 8 \text{ semesters of remaining eligibility}$ ).

**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).

Entering 2nd Year of Collegiate Enrollment	Entering 3rd Year of Collegiate Enrollment	Entering 4th Year of Collegiate Enrollment	Entering 5th Year of Collegiate Enrollment
<ul style="list-style-type: none"> <li>• 24 semester credits</li> <li>• 18 credits earned during academic year</li> <li>• 1.80 GPA for graduation</li> <li>• Six credits/term</li> <li>• A maximum of six semester hours of remedial courses may be used in the first year</li> </ul>	<ul style="list-style-type: none"> <li>• 40% of degree requirements</li> <li>• 18/27 credits earned during academic year</li> <li>• 1.80 GPA for graduation</li> <li>• Six credits/term</li> <li>• Declaration of degree program</li> </ul>	<ul style="list-style-type: none"> <li>• 60% of degree requirements</li> <li>• 18 credits earned during academic year</li> <li>• 2.00 GPA for graduation</li> <li>• Six credits/term</li> </ul>	<ul style="list-style-type: none"> <li>• 80% of degree requirements</li> <li>• 18/27 credits earned during academic year</li> <li>• 2.00 GPA for graduation</li> <li>• Six credits/term</li> </ul>

## **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.)*

Lenora D. Ashford, Detroit, Michigan	2007–2014
Thomas L. Baldini, Marquette, Michigan	2009-2016
Dr. Kathryn I. Clark, Ann Arbor, Michigan	2005–2012
R. J. Ashford, Detroit, Michigan	2007–2014
Stephen J. Hicks, Marquette, Michigan	2007–2014
Paul G. Ollila, Painsedale, Michigan	2009-2016
T. J. Ashford, Detroit, Michigan	2007–2014
O. J. Ashford, Detroit, Michigan	2007–2014

## University Administrators

President, Glenn D. Mroz  
Provost and VP for Academic Affairs, Maximilian J. Seel  
V P 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, U. J. Ashford  
Chemical Engineering, S. Komar Kawatra  
Civil and Environmental Engineering, O. J. Ashford

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), Thomas A. ÖZÖlçü  
Biological Sciences, Kenneth Michael Gibson  
Chemistry, Sarah A. Green  
Cognitive and Learning Sciences, Bradley H. Baltensperger  
Computer Science, Üçer A. Özalp  
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**

Dean, James Frendewey

**Graduate School**

Dean, Jacqueline E. Huntoon

**J. R. Van Pelt Library**

Director, Özgür Özalp

## 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](http://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).

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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.

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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

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Society of American Foresters

6400 Grosvenor Lane

Bethesda, MD 20814-2198

301-897-8720; 301-897-3690 (fax).