

Undergraduate Course Descriptions

Effective Fall 2018

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

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

Pre-Requisite(s): ACC 2000

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 2000

ACC 3100 - Accounting Theory/Practice II

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

Credits: 3.0

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

Semesters Offered: Spring

Pre-Requisite(s): ACC 3000 and FIN 3000(C)

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

ACC 3600 - Foundations of Taxation

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

Credits: 3.0

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

Semesters Offered: Fall

Pre-Requisite(s): ACC 2000

ACC 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 3000 or ACC 5050

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 3000

ACC 4500 - Managerial/Cost Accounting II

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

Credits: 3.0

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

Semesters Offered: Spring

Pre-Requisite(s): ACC 3500

ACC 4600 - Advanced Tax Topics

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

Credits: 3.0

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

Semesters Offered: Spring

Pre-Requisite(s): ACC 3600

ACC 4700 - Governmental and Not-for-Profit Accounting

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

Credits: 3.0

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

Semesters Offered: Spring

Pre-Requisite(s): ACC 3000

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 ACC 5050

ACC 4990 - Special Topics in Accounting

Examines current issues in Accounting and other topics of interest to faculty and students in greater depth.

Credits: variable to 3.0; Repeatable to a Max of 6

Semesters Offered: On Demand

Restrictions: Permission of instructor required

Pre-Requisite(s): ACC 3000

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: Fall, Spring

AF 0130 - Air Force Elite Forces Workout

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

Credits: 1.0; Graded Pass/Fail Only

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

Semesters Offered: On Demand

Restrictions: Permission of instructor required

Pre-Requisite(s): AF 0120

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, Spring

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

Pre-Requisite(s): AF 2002

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 operations and installations, principles of war and tenets of Airpower, policy and strategy, and human relations in the Air Force. Leadership lab is mandatory for AFROTC cadets and complements this course by providing cadets with followership and leadership experiences.

Credits: 1.0

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

Semesters Offered: Spring

AF 2001 - Evolution of US Air & Space Power I

This course provides students with some knowledge-level understanding for the employment of air and space power, from an institutional, doctrinal, and historical perspective.

Credits: 1.0

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

Semesters Offered: Fall

AF 2002 - Evolution of US Air & Space Power II

This course provides the students with some knowledge-level understanding for the employment of air and space power, from an institutional, doctrinal, and historical perspective. Leadership and communications lessons and exercises will prepare cadets for upcoming summer training program.

Credits: 1.0

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

Semesters Offered: Spring

Pre-Requisite(s): AF 2001

AF 2010 - Evolution of US Air And Space Power I for Non-AFROTC Students

For non-AFROTC students. AFROTC cadets should enroll in AF2001. This course provides students with some knowledge-level understanding for the employment of air and space power, from an institutional, doctrinal, and historical perspective. Post-WWI through end of WWII will be discussed. Leadership and communications lessons and exercises.

Credits: 1.0

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

Semesters Offered: Fall

Restrictions: Permission of instructor required

AF 2020 - Evolution of US Air and Space Power II for Non-AFROTC Students

For non-AFROTC students. AFROTC students should enroll in AF2002. This course provides students with some knowledge-level understanding for the employment of air and space power, from an institutional, doctrinal, and historical perspective. Leadership and communications lessons and exercises. Leadership lessons designed to prepare cadets for upcoming summer training program.

Credits: 1.0

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

Semesters Offered: Spring

Restrictions: Permission of instructor required

Pre-Requisite(s): AF 2010

AF 3001 - Leadership Studies I

Study and practice of leadership in civilian and military organizations. Topics include leadership principles, problem solving, management fundamentals, counseling, motivation, mentoring, and effective communication. Various leadership theories are discussed. The course includes discussion, informal lecture, case studies, self-evaluation of leadership traits, and experiential exercises.

Credits: 3.0

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

Semesters Offered: Fall

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

AF 3002 - Leadership Studies II

Study of leadership in civilian and military institutions. Topics include 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: (0-2-2)

Semesters Offered: Spring

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

AF 3010 - Leadership Studies I for Non-AFROTC Students

For non-AFROTC students. AFROTC cadets should enroll in AF3001. Study and practice of leadership in civilian and military organizations. Topics include leadership principles, problem solving, management fundamentals, counseling, motivation, mentoring, and effective communication. Various leadership theories are discussed. The course includes discussion, informal lecture, self-evaluation of leadership traits, and experiential exercises.

Credits: 3.0

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

Semesters Offered: Fall

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

AF 3020 - Leadership Studies II for Non-AFROTC Students

For non-AFROTC students. AFROTC cadets should enroll in AF3002. Study of leadership in civilian and military institutions. Topics include 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: (0-3-0)

Semesters Offered: Spring

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

AF 4001 - National Security Affairs I

This course is designed to develop an understanding of the nature of conflict and how the United States military forces are developed, organized, and employed. Topics include the need for national security, the evolution and formulation of American defense policy and strategy, the origins of regional security issues, cross cultural competence, and joint doctrine.

Credits: 3.0

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

Semesters Offered: Fall

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

AF 4002 - National Security Affairs II

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

Credits: 3.0

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

Semesters Offered: Spring

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

AF 4010 - National Security Affairs I - for Non-AFROTC Students

For non-AFROTC students. AFROTC cadets should enroll in AF4001. This course is designed to develop an understanding of the nature of conflict and how the United States military forces are developed, organized, and employed. Topics include the need for national security, the evolution, and formulation of American defense policy and strategy, the origins of regional security issues, cross cultural competence, and joint doctrine.

Credits: 3.0

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

Semesters Offered: Fall

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

AF 4020 - National Security Affairs II - for Non-AFROTC Students

For non-AFROTC students. AFROTC cadets should enroll in AF4002. This course examines selected roles of the military in society, unconventional warfare, current issues affecting the military profession, and the military justice system. Special topics of interest focus on information warfare, the law of armed conflict, the military as a profession, and officership.

Credits: 3.0

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

Semesters Offered: Spring

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

Army ROTC

AR 0340 - Internship in Advanced Military Leadership

A rigorous program of physical conditioning, leadership development, and team building training. Offered the summer semester after completion of the Cadets junior year of college. Course completed off campus.

Credits: 3.0; Graded Pass/Fail Only

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

Semesters Offered: Summer

Restrictions: Permission of department required

AR 1001 - Introduction to the Army and Critical Thinking

Introduces cadets to the competencies that are critical for effective leadership.

Cadets learn how the personal development of "life skills" such as critical thinking, time management, goal setting, stress management, and comprehensive fitness relate to the Army profession.

Credits: 1.0

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

Semesters Offered: Fall

AR 1003 - Leadership and Competence

Introduces Cadets to the competencies that are critical for adaptive leadership.

Cadets learn the basics of the communication process and the importance of developing the essential skills to effectively communicate in the Army. Students will examine the Army profession in depth.

Credits: 1.0

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

Semesters Offered: Spring

AR 1011 - Basic Leadership Lab I

Practicum in basic military topics such as drill and ceremony, emergency preparedness, survival skills, and military communication.

Credits: 1.0

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

Semesters Offered: Fall

AR 1012 - Basic Leadership Lab II

Practicum in basic military topics such as first aid, teambuilding, orienteering, profession of arms, and ethics in problem solving.

Credits: 1.0

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

Semesters Offered: Spring

AR 2001 - Leadership and Decision Making

Explores the dimensions of creative tactical leadership styles by examining team dynamics and historical leadership theories that form the basis of the Army leadership framework. Aspects of motivation and team building are practiced through planning, executing, and assessing team exercises

Credits: 1.0

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

Semesters Offered: Fall

AR 2002 - Army Doctrine and Team Development

Examines the challenges of leading teams in complex operational environments.

The course highlights terrain analysis, patrolling, and operation orders. Cadets develop greater self-awareness as they assess their own leadership styles and practice communication and team building skills.

Credits: 1.0

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

Semesters Offered: Spring

AR 2011 - Intermediate Leadership Lab I

Practicum in basic military topics, such as drill and ceremony, emergency preparedness, survival skills, and military communication.

Credits: 1.0

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

Semesters Offered: Fall

AR 2012 - Intermediate Leadership Lab II

Practicum in basic military topics, such as first aid, teambuilding, orienteering, profession of arms, and ethics in problem solving.

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; 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; Graded Pass/Fail Only

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

Semesters Offered: Spring

AR 3001 - Warfighting Functions

Teaches cadets to plan, coordinate, navigate, motivate, and lead a squad and platoon in the execution of mission during a classroom PE, a leadership lab, or during a leader training course.

Credits: 2.0

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

Semesters Offered: Fall

Co-Requisite(s): AR 3011

AR 3002 - Leadership and Operations

Cadets will study, practice, and apply the fundamentals of Army leadership, officership, Army value and ethics, personal development, and small unit tactics at the platoon level.

Credits: 2.0

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

Semesters Offered: Spring

Co-Requisite(s): AR 3012

Pre-Requisite(s): AR 3001

AR 3011 - Advanced Leadership Lab I

Practicum in basic military topics, such as drill and ceremony, emergency preparedness, survival skills, and military communication.

Credits: 1.0

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

Semesters Offered: Fall

Co-Requisite(s): AR 3001

AR 3012 - Advanced Leadership Lab II

Practicum in basic military topics, such as first aid, teambuilding, orienteering, profession of arms, and ethics in problem solving.

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 3775 - U.S. Military History for the Professional Officers

History of the American military and its place in American society in both peace and war from the colonial period until the present.

Credits: 3.0

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

Semesters Offered: Summer

Restrictions: Permission of department required

AR 4001 - Mission Command I and the Army Profession

Completes the Cadet to commissioned officer transition. Course stresses mission command and ethics to assist the Cadet in further embracing their role as an Army officer.

Credits: 2.0

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

Semesters Offered: Fall, Spring

Co-Requisite(s): AR 4011

Pre-Requisite(s): AR 3001 and AR 3002

AR 4004 - Mission Command II and the Company Grade Officer

Course will teach critical knowledge, skills, abilities, and competencies that newly commissioned officers will need to succeed in their first unit of assignment. Cadets will examine the Army profession in depth.

Credits: 2.0

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

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: 1.0

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

Semesters Offered: On Demand

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

Atmospheric Science**ATM 4640 - Fundamentals of Atmospheric Science**

Fundamental principles of atmospheric science, including thermodynamics, aerosol and cloud physics, radiative transfer, and atmospheric dynamics.

Credits: 3.0

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

Semesters Offered: Fall - Offered alternate years beginning with the 2015-2016 academic year

Pre-Requisite(s): (PH 2200 or PH 2260) and (PH 1360 or PH 2300) and MA 3160 and (MA 3520 or MA 3521 or MA 3530 or MA 3560)

Biomedical Engineering**BE 2100 - Undergraduate Biomedical Engineering Seminar**

An overview of biomedical engineering designed especially for freshmen and sophomores that includes presentations by faculty, members of the community and other guest lecturers. Topics ranging from clinical engineering through basic biomedical engineering research are covered.

Credits: 1.0; Graded Pass/Fail Only

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

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Class(es): Freshman, Sophomore

BE 2110 - Statistical Methods for Biomedical Engineering

Topics include descriptive statistics, sampling methods, probability, statistical inference, causality, elementary design of experiments, statistical process improvement methods including Six-Sigma techniques, clinical trial methodology, and variance analysis.

Credits: 3.0

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

Semesters Offered: Spring

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

BE 2400 - Cellular and Molecular Biology

General principles and engineering applications of science and biology, including cell biology, physiology, molecular biology, genetics, and biotechnology.

Credits: 3.0

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

Semesters Offered: Fall

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

Pre-Requisite(s): CH 1150 and MA 1160 or MA 1161

BE 2700 - Biomedical Signals & Systems

Introduces the origin, processing and interpretation of biological signals. Mathematical modeling techniques used in the analysis of linear systems. Topics include: Fourier, Laplace and z-transforms, signal comparison techniques, power spectrum analysis, 2-dimensional signals, transfer functions, convolution, and simulations.

Credits: 3.0

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

Semesters Offered: Fall

Pre-Requisite(s): CH 1150 or CH 1112 and PH 2100 and MA 2160 and ENG 1102

BE 2800 - Biomaterials I: Fundamental Materials Science and Engineering

Introduction to the fundamental materials science principles and different classes of biomaterials (metals, ceramics, polymers and their composites), and some practical professional issues concerning the field of biomaterials.

Credits: 3.0

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

Semesters Offered: Spring

Pre-Requisite(s): BE 2400

BE 3300 - Biomechanics I: Statics and Dynamics

Course provides overview of two and three-dimensional force and structure systems and their applicability to human body. Course topics will include principle of equilibrium, concept of free-body diagram, moment of inertia, centroids. Kinematics and equations of motion, principle of energy, work and momentum. Course materials tailored for biological applications, particularly for applications at human organ level.

Credits: 3.0

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

Semesters Offered: Fall

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

Pre-Requisite(s): BE 2400 and (MA 2321 or MA 2320 or MA 2330) and (MA 3521 or MA 3520 or MA 3530) and BL 2010

BE 3350 - Biomechanics II: Soft Tissue and Bio-Fluid Mechanics

This course teaches basic principles of mechanics that are closely related to human soft tissue and bio-flow, particularly, at the human organ level. Emphases are given to both engineering fundamentals and biomedical applications.

Credits: 3.0

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

Semesters Offered: Spring

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

Pre-Requisite(s): BE 3300

BE 3400 - Experimental Techniques in Biomedical Engineering

introduction to the experimental techniques used in biomedical engineering, technical report writing, and record keeping.

Credits: 2.0

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

Semesters Offered: Fall

Pre-Requisite(s): BE 2800

BE 3550 - Fluid Mechanics

This course introduces fundamental fluid mechanics principles in a unified fashion so that students can describe biological fluid problems in precise mathematical language. Topics include nature of fluids, hydrostatics, differential and integral equations about conservation of mass and momentum, dimensional analysis and various types of flow.

Credits: 4.0

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

Semesters Offered: Spring

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

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

BE 3700 - Biomedical Instrumentation

Introductory theory of measurement and analysis from biological systems. Covers the principles and use of transducers, data recording and analysis systems and signal processing techniques. Example measurements include life science research and clinical measurements such as the vital signs.

Credits: 3.0

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

Semesters Offered: Spring

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

Co-Requisite(s): BE 3701

Pre-Requisite(s): EE 3010 and PH 2200(C) and BL 2020(C) and BE 2700

BE 3701 - Biomedical Instrumentation Lab

Laboratory exercises to demonstrate basic instrumentation principles and biomedical measurements. Students will learn how to make non-invasive measurements on themselves and how to evaluate measurement instrumentation. Course will coincide with BE3700 lectures.

Credits: 1.0

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

Semesters Offered: Spring

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

Co-Requisite(s): BE 3700

BE 3800 - Biomaterials II: Properties and Biological Interactions

Biomaterials properties including structure-function relationships (materials composition and properties), protein/cell materials interactions, characterization methods, and handling and processing considerations.

Credits: 3.0

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

Semesters Offered: Fall

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

Pre-Requisite(s): BE 2700(C) and BE 2800

BE 4000 - Independent Study

Students undertake an independent study under the guidance of a Biomedical Engineering faculty member. The course of study may either be research or academic and is decided upon between the 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 4115 - Finite Element Modeling

This course teaches both fundamentals of finite element theory and hands-on experience for bio engineers.

Credits: 3.0

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

Semesters Offered: Spring

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

Pre-Requisite(s): (MA 2320 or MA 2321) and (MA 3520 or MA 3521) and (BE 3350 or MEEM 2150)

BE 4200 - Cellular and Molecular Biology II

Covers, at an advanced level, the general principles and engineering applications of science and biology, including cell biology, physiology, molecular biology, genetics, and biotechnology.

Credits: 3.0

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

Semesters Offered: Spring

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

Pre-Requisite(s): BE 2400

BE 4230 - Stem Cell and Tissue Engineering

This course will introduce basic concepts of tissue engineering; scaffold materials and biotechnologies for tissue engineering; basic concept of stem cells; review of stem cell sources and related policies; current progress in stem cell research, and application of stem cells in tissue engineering and regenerative medicine.

Credits: 3.0

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

Semesters Offered: Spring

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

Pre-Requisite(s): BE 2400 and BE 3350 and BE 3800

BE 4250 - Biomedical Optics

Light plays a significant role in modern clinical diagnostics and in the clinical treatment of disease. Examples include non-invasive surgery, optical biopsy, and cancer therapy. This course will focus on the study of how light propagates through biological tissue.

Credits: 3.0

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

Semesters Offered: Spring - Offered alternate years beginning with the 2014-2015 academic year

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

Pre-Requisite(s): (MA 2320 or MA 2321 or MA 2330) and (MA 3520 or MA 3521 or MA 3530 or MA 3560) and MA 3160

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

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

Pre-Requisite(s): BE 3800

BE 4330 - Biomimetic Materials

This course introduces students to biologically inspired approaches to design functional biomaterials. Topics include the discovery and incorporation of biological designs into novel materials and their application in the biomedical field.

Credits: 3.0

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

Semesters Offered: Fall - Offered alternate years beginning with the 2014-2015 academic year

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

Pre-Requisite(s): BE 3350 and BE 3800

BE 4335 - Smart Polymers

This course introduces students to smart polymers that change their physical properties in response to various environmental stimuli. Topics include the molecular origin of the stimuli responsiveness of these materials and their applications in the biomedical field.

Credits: 3.0

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

Semesters Offered: Fall - Offered alternate years beginning with the 2015-2016 academic year

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

Pre-Requisite(s): BE 3350 and BE 3800

BE 4350 - Cell Biomechanics and Mechanical Transduction

This course is designed to introduce the mechanical analysis and characterization of mammalian cells. Mechanotransduction, whereby cells detect loading and respond to the morphology and mechanical properties of the surrounding extracellular matrix, will be emphasized.

Credits: 3.0

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

Semesters Offered: Fall

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

Pre-Requisite(s): BE 2400 and BE 3350 and BE 3800

BE 4410 - Medical Imaging

This course covers the physical nature of the interactions between the waves and matter, especially the biological tissues, principle imaging modalities used in modern medicine and the common techniques used for the processing of the resulting images.

Credits: 3.0

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

Semesters Offered: Spring - Offered alternate years beginning with the 2018-2019 academic year

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

Pre-Requisite(s): BE 3700

BE 4510 - Cardiovascular Engineering

Fundamental cardiovascular pathology and the biomedical engineering approaches being developed and used toward problems resulting in significant cardiovascular deficiency such as myocardial infarction, chronic kidney disease, atherosclerosis, and heart valve disease.

Credits: 3.0

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

Semesters Offered: Fall

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

Pre-Requisite(s): BL 2020 and BE 2400

BE 4670 - Micro & Nano Technologies

This course will introduce students to micro- and nano- technologies and the processes involved in manufacturing. Particular emphasis will be on their use in biomedical applications. Goal is to provide information beneficial in research and development, and the industry.

Credits: 3.0

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

Semesters Offered: Fall

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

Pre-Requisite(s): BE 3700

BE 4700 - Biosensors: Fabrication & Applications

This course introduces the student to the fundamentals of biosensor development and applications. It provides an understanding of biological components, immobilization methods, transducers, and fabrication techniques.

Credits: 3.0

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

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

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

Pre-Requisite(s): BE 3700 and BE 3701

BE 4755 - Medical Devices

An introduction to medical devices used for diagnosis, monitoring, and treatment in clinical medicine. Topics covered include product planning, reliability, clinical trial design, regulatory as well as technical aspects of common medical devices.

Credits: 3.0

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

Semesters Offered: Fall

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

BE 4770 - Biomedical Microcontrollers

The focus of this course is to provide biomedical engineering students the necessary skills to develop microcontroller-based devices. Provides basic knowledge on computer programming languages, microcontrollers, digital circuits, and microcontroller development kits. Students will design and fabricate a microcontroller-based device using a microcontroller development kit for a specific biomedical application.

Credits: 3.0

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

Semesters Offered: Fall - Offered alternate years beginning with the 2016-2017 academic year

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

Pre-Requisite(s): BE 3700 and BE 3701

BE 4800 - Biomaterials Interfaces

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

Credits: 3.0

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

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

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

Pre-Requisite(s): BE 3800

BE 4850 - Tissue Mechanics

This course integrates continuum mechanics, experiments, and computational methods to understand soft tissue mechanics. The first half of the course is dedicated to building continuum mechanics foundation, which will be used to formulate constitutive equations for arteries and the heart in the second half.

Credits: 3.0

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

Semesters Offered: Fall

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

Pre-Requisite(s): BE 3300

BE 4900 - Biomedical Design Fundamentals

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

Credits: 2.0

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

Semesters Offered: Spring

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

BE 4901 - Biomedical Design Project I

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

Credits: 2.0

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

Semesters Offered: Fall

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

Pre-Requisite(s): BE 3500(C) and BE 3600 and (BE 3750 or MEEM 4180) or (BE 3350 and BE 3700 and BE 3701 and BE 3800) and BE 4900

BE 4910 - Biomedical Design Project II

Continuation of Biomedical Design Project I (BE4901) under faculty guidance. Emphasizes design and testing of prototypes. Requires work project notebooks, oral and written reports, and presentations.

Credits: 2.0

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

Semesters Offered: Spring

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

Pre-Requisite(s): BE 4900 and BE 4901

BE 4930 - Biomedical Engineering Topics

Biomedical engineering courses will be offered on new or emerging technical subjects depending on student demand and faculty interest and expertise.

Credits: variable to 6.0; May be repeated

Semesters Offered: Fall, Spring, Summer

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

Biological Sciences

BL 0600 - Clinical Practicum and Career Preparation Seminar

Presents an overview of hospital-based clinical practicum experiences and outlines pathways to national certification. Also addresses other career options for the clinical laboratory scientist. Credits do not count toward graduation.

Credits: 1.0; Graded Pass/Fail Only

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

Semesters Offered: Spring

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

BL 1020 - General Biology II

Discussion of the major principles by which life is organized. Topics include scientific methods, biological chemistry, cell structure and organization, multicellular organization, diversity of organisms, energetics and photosynthesis, cellular reproduction genetics, gene structure and expression, and recombinant DNA.

Credits: 4.0

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

Semesters Offered: Spring, Summer

Pre-Requisite(s): BL 1010

BL 1040 - Principles of Biology

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

Credits: 4.0

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

Semesters Offered: Fall, Summer

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

BL 1580 - First Year Experience in Biological Sciences

Introduction to fields and career opportunities in the biological sciences.

Credits: 1.0

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

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Major(s): Biological Sciences; Must be enrolled in one of the following Class(es): Freshman, Sophomore

BL 1590 - First Year Experience in Health Professions

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

Credits: 1.0

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

Semesters Offered: Fall

Restrictions: May not be enrolled in one of the following Major(s): Pre-Professional; Must be enrolled in one of the following Class(es): Freshman, Sophomore

BL 1600 - First Year Experience in Medical Laboratory Science

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

Credits: 1.0

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

Semesters Offered: Fall

BL 1710 - Medical Terminology

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

Credits: 1.0

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

Semesters Offered: Fall

BL 2000 - Biology of Movement and Meditation

Students will explore the science behind the practice of yoga, including poses, meditation, anatomy & physiology. Will read peer-reviewed literature excerpts regarding yoga research. Physical practice, no prior experience necessary. Yoga supplies required.

Credits: 3.0

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

Semesters Offered: Fall, Spring, Summer

BL 2001 - Valuing the Great Lakes

The Great Lakes are used as the subject to examine environmental issues. A combination of reading, lecture, and discussion will be used to study the unique ecology, biology, and history of the Great Lakes.

Credits: 3.0

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

Semesters Offered: Fall

BL 2004 - Cooking and Nutrition

Students will learn the basics of nutritional science while preparing healthy meals. Emphasis will be on the physiology of food metabolism and critically examining food claims. Students will also learn to make appropriate choices regarding food and cooking techniques.

Credits: 3.0

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

Semesters Offered: Summer

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

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, muscles, the nervous system, and special senses.

Credits: 3.0

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

Semesters Offered: Fall, Summer

Pre-Requisite(s): CH 1000 or (CH 1150 and CH 1151)

BL 2011 - Anatomy & Physiology I Lab

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

Credits: 1.0

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

Semesters Offered: Fall, Summer

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

BL 2020 - Anatomy & Physiology II

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

Credits: 3.0

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

Semesters Offered: Spring

Pre-Requisite(s): BL 2010

BL 2021 - Anatomy & Physiology II Lab

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

Credits: 1.0

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

Semesters Offered: Spring

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

BL 2100 - Principles of Biochemistry

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

Credits: 3.0

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

Semesters Offered: Fall

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

BL 2160 - Botany

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

Credits: 4.0

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

Semesters Offered: Spring

BL 2170 - Zoology

Biology of animals from first organized multi-cell through Hominids; the origin and evolution of the metazoa phyla, their physiology, development, ecology, behavior, natural history, and systematics.

Credits: 4.0

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

Semesters Offered: Fall

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, Summer

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 2410 - Basic Medical 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): Medical 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 2700 - Principles of Bioinformatics

This course discusses the core concepts in bioinformatics and how biology, math, and computer science combine to form the basis of bioinformatics.

Students will be exposed to the applications of bioinformatics in analysis of DNA and protein sequences and be introduced to common methods for processing this data.

Credits: 3.0

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

Semesters Offered: Spring

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, Summer

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

BL 3000 - Job Shadowing in Health Professions

Designed for students to observe health professionals in clinical settings. Course will cover prerequisites, HIPPA rules, and shadowing etiquette. Students will complete at least 15 hours of shadowing arranged with the cooperating hospital or clinic.

Credits: 1.0; Repeatable to a Max of 3

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

Semesters Offered: On Demand

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

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

BL 3006 - Graduate Health Program Application Preparation

Course will assist students with the application process for graduate health professional programs (medical, dental, PA, etc.). Topics covered will include writing about experiences, developing a personal statement, asking for letters of recommendation, and conducting interviews.

Credits: 1.0

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

Semesters Offered: Spring

Restrictions: Permission of instructor required

BL 3010 - General Entomology

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

Credits: 4.0

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

Semesters Offered: Fall

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

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

BL 3012 - Essential Cell Biology

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

Credits: 3.0

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

Semesters Offered: Spring

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

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

BL 3080 - Biological Concepts for Engineers

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

Credits: 3.0

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

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Major(s): Environmental Engineering, Civil Engineering

BL 3190 - Evolution

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

Credits: 3.0

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

Semesters Offered: Spring

Pre-Requisite(s): BL 1010 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, Summer

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

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

BL 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): Medical 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, Summer

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

Pre-Requisite(s): BL 2200 or FW 3320

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

Pre-Requisite(s): BL 1040 or BL 3080

BL 3400 - Principles of Ecology

Study of both accepted and currently debated principles that describe ecological relationships at the organism, population, community, and ecosystem levels.

Credits: 4.0

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

Semesters Offered: Fall

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

BL 3611 - Principles and Practice of Phlebotomy

This course covers the collection, processing, and transportation of specimens for laboratory analysis. Emphasis will be placed on hands-on phlebotomy training using proper techniques and precautions.

Credits: 1.0; Graded Pass/Fail Only

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

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Major(s): Medical Laboratory Science; May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): BL 2410

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, Summer

Restrictions: Must be enrolled in one of the following Major(s): Bioinformatics, Medical Laboratory Science, Pharmaceutical Chemistry, Biochem & Molec Biology-Bio Sc, Biomedical Engineering, Biological Sciences; May not be enrolled in one of the following Class(es): Freshman, Sophomore

Pre-Requisite(s): BL 1020 or BL 1040 or BL 2020 or BE 2400

BL 3780 - Medical Parasitology Laboratory

Stresses the visual identification of common human parasites.

Credits: 1.0

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

Semesters Offered: Spring

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

Pre-Requisite(s): BL 1710 and BL 2410

BL 3782 - Writing Practicum in Biology

Students will develop and improve their skill level in searching for scientific literature, incorporating that into scientific writing, evaluating and incorporating the work of others, and develop critique skills for review of scientific source material and basic statistical methods.

Credits: 2.0

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

Semesters Offered: Fall, Spring

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

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, Summer

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

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

BL 3990 - Biological Sciences Teaching Experience

Development of teaching skills through assisting in the instruction of a section of biological sciences laboratory. Students gain experience in leadership, group work, organization skills, laboratory preparation, and laboratory instruction.

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

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required

BL 4000 - Research in Biology

A literature and laboratory research problem that culminates in a written report on the work performed.

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

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required

BL 4001 - Honors Research in Biology

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

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

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required

BL 4008 - Summer Workshop on Genome Editing of Human Disease Genes

The course will focus on a survey and choice of disease-related genes, designing and constructing genome-editing tools, assaying for genome-editing efficiency, the detection and verification of the edited genes, and finally the production of stable disease-gene mutant cell lines.

Credits: 3.0

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

Semesters Offered: Summer

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

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, Summer

Pre-Requisite(s): (BL 1020 or BL 1040 or BE 2400) 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, Summer

Pre-Requisite(s): BL 4010

BL 4030 - Molecular Biology

Molecular biology of gene structure, expression and regulation. Also topics covering various molecular techniques and applications of these techniques and biotechnology.

Credits: 3.0

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

Semesters Offered: Fall, Summer

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

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

BL 4034 - Community Ecology and Evolutionary Dynamics

This is an advanced course that looks at the study of ecology and evolutionary biology at the community level: how populations interact with the abiotic environment and each other to determine patterns of diversity, distribution, and abundance of plants and animals.

Credits: 3.0

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

Semesters Offered: Fall - Offered alternate years beginning with the 2014-2015 academic year

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

Pre-Requisite(s): BL 3400 and BL 3190

BL 4035 - Bioimaging

Current concepts in light and electron microscopy and scanning probe techniques. Theory and practice of fluorescence (including confocal and 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 4036 - Ecology and Evolution of Interactions Between Plants and Insects

Plants and insects have played major roles in influencing each others evolutionary diversification. We will examine the ecology and evolution of plant-insect interactions in basic and applied contexts. A solid foundation of tools in ecology and evolution will be established and class will include lectures and interactive discussions from readings of the primary literature.

Credits: 3.0

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

Semesters Offered: Fall - Offered alternate years beginning with the 2013-2014 academic year

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

Pre-Requisite(s): BL 3400 and BL 3190

BL 4038 - Epigenetics

An introduction to the fundamentals of epigenetic control that is not encoded by genomic DNA sequences of an organism. Topics include major regulatory mechanisms including DNA methylation, histone modification, and non-coding RNA (ncRNA) mediated gene regulation.

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 3300 or BL 4030

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 4044 - Human Pathophysiology

Course will cover abnormal function (physiology) and investigate the signs and symptoms of major diseases in humans. Extension of Anatomy & Physiology by working through the systems of the human body. Course will include a clinical focus and case-study approach.

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 2010 and BL 2020

BL 4052 - Fluorescence and Video Microscopy of Biological Specimens

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

Credits: 2.0

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

Semesters Offered: Fall, 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 4070 - Environmental Toxicology

Introduction to the range of anthropogenic pollutants released into the environment. Concepts of bioaccumulation, biomagnification and environmental persistence, modes of toxicity and detoxification, transport and fate in aquatic and terrestrial ecosystems. Toxic equivalent factors and quotients, regulatory guidelines and practices.

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): (BL 1020 or BL 1040) and CH 1150 and CH 1160

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

Restrictions: Permission of instructor required

BL 4120 - Environmental Remediation

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

Credits: 3.0

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

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

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

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

BL 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 4200 - Microbial Physiology

Structure and function of microorganisms, with emphasis on mechanisms for responding to changing environmental and nutritional conditions.

Credits: 3.0

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

Semesters Offered: Fall - Offered alternate years beginning with the 2018-2019 academic year

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

Pre-Requisite(s): BL 3210 or BL 3310

BL 4370 - Advanced 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 4421 - Lake Superior Exploration

A field intensive course with significant time spent on a research vessel (R/V Agassiz or other) where students will learn the use of a variety of state-of-the-art techniques to characterize biological communities and measure important physical and biological processes.

Credits: 3.0

Lec-Rec-Lab: (4-0-6)

Semesters Offered: Summer - Offered alternate years beginning with the 2018-2019 academic year

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

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: Fall - Offered alternate years beginning with the 2018-2019 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 4447 - Stream Ecology

Field course combining river and stream ecosystem and foodweb study with fishes in lake systems. Students will be exposed to research methods used in lakes for comprehensive abiotic and biotic understanding.

Credits: 4.0

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

Semesters Offered: Summer - Offered alternate years beginning with the 2019-2020 academic year

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

Pre-Requisite(s): BL 1010 or BL 1040 or BL 3400

BL 4450 - Limnology

The study of biological, physical, and chemical processes of freshwater ecosystems using a watershed perspective, with emphasis on local lakes.

Credits: 3.0

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

Semesters Offered: Spring

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

BL 4461 - Ecosystem Ecology

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

Credits: 3.0

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

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

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

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

BL 4465 - Biological Oceanography

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

Credits: 3.0

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

Semesters Offered: Spring

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

Pre-Requisite(s): BL 1010 or BL 1040 or BL 3080

BL 4510 - Senior Capstone Experience

Reading, interpreting, and integrating information from the primary literature of biological sciences. Emphasizes oral and written presentation skills.

Credits: 2.0

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

Semesters Offered: Fall, Spring

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

BL 4530 - Senior Research Capstone Experience

Reading, interpreting, and integrating information from the primary literature and research project data. Emphasizes oral and written presentations as well as peer review.

Credits: 1.0

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

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Major(s): Biological Sciences, Biochem & Molec Biology-Bio Sc, Bioinformatics; Must be enrolled in one of the following Class(es): Senior

Pre-Requisite(s): BL 4000(C) or BL 4001(C) or BL 4995(C)

BL 4550 - Clinical Chemistry

A study of clinical biochemistry of the human body. Theory and practical applications used in routine analysis of body fluids. Includes the study of electrolyte balance, acid base balance, and the functions of major organs and systems.

Credits: 3.0

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

Semesters Offered: Spring

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

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

BL 4610 - Medical Laboratory Science Medical Practicum I

Practical and didactic training in clinical chemistry, immunopathology, and medical microbiology under the direction of National Accrediting Agency for the Clinical Laboratory Sciences (NAACLS)-approved/accredited hospital internship program personnel.

Credits: 15.0

Lec-Rec-Lab: (15-0-0)

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Major(s): Medical Laboratory Science

BL 4611 - Medical Laboratory Science Medical Practicum II

Practical and didactic training in hematology, urinalysis, and immunohematology under the direction of National Accrediting Agency for the Clinical Laboratory Sciences (NAACLS)-approved/accredited hospital internship program personnel.

Credits: 15.0

Lec-Rec-Lab: (15-0-0)

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Major(s): Medical Laboratory Science

Pre-Requisite(s): BL 4610

BL 4612 - Medical Laboratory Science University Clinical Practicum

Practical and didactic training in Medical Laboratory Science for students who have completed the NAACLS accredited MLS 4+1 degree. Course is under direction of the MLS Practicum Coordinator and conducted in affiliated hospitals. Upon completion, students are eligible to sit for the ASCP Board Registry Exam.

Credits: 10.0

Lec-Rec-Lab: (0-0-10)

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of department required

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

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

BL 4660 - Current Topics in Medical Laboratory Science

Recent developments in Clinical Laboratory Science.

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

Semesters Offered: Fall, Spring

Restrictions: Permission of instructor required

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): Medical 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): Medical Laboratory Science, Biological Sciences; Must be enrolled in one of the following Class(es): Junior, Senior

Pre-Requisite(s): BL 4720(C)

BL 4750 - Medical Laboratory Instrumentation

An overview of the principles, applications, and selection of instruments used in medical 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: (1-0-3)

Semesters Offered: Spring

BL 4752 - Cancer Biology

Emphasis on characteristic genetic, molecular, and cellular changes leading to cancer. Topics will include the role of tumor viruses, oncogenes, tumor suppressors, immortalization, apoptosis, and angiogenesis in cancer initiation and/or progression. Consideration of current therapies and future directions for treatment.

Credits: 3.0

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

Semesters Offered: Spring

Pre-Requisite(s): BL 3012 or BL 4370 or BE 2400

BL 4800 - Molecular Diagnostics

This course provides the scientific background behind modern molecular techniques applies in the diagnosis of human diseases. Topics to be covered include nucleic acid structure and function as well as introduction to nucleic acid characterization techniques used in disease diagnosis and genetic disorders.

Credits: 5.0

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

Semesters Offered: Spring

Pre-Requisite(s): BL 2200

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 2200 and BL 4030(C)

BL 4980 - Medical Laboratory Science Core Concept Integration and Application

SML 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): Medical 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

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

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

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

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

BUS 3900 - Business Internship

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

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

Semesters Offered: Fall, Spring, Summer

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

BUS 4900 - Research Projects

Under the general guidance of a faculty member, students read, conduct research, and prepare reports and papers as required. The SBE's Curriculum Committee must approve the subject of the proposed project.

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

Semesters Offered: On Demand

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

BUS 4950 - Business Project

Students work individually or in a team on a project under the guidance of a faculty advisor. The student(s) analyze a problem, develop a project plan, summarize findings, and make recommendations.

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

Semesters Offered: On Demand

Restrictions: Permission of instructor required; 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 3.0; Repeatable to a Max of 6

Semesters Offered: On Demand

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

BUS 4991 - Business Development Experience I

Provides students with hands-on entrepreneurial learning experience by placing them in close proximity of real world entrepreneurs and innovators. Students ascertain commercial viabilities of intellectual property, senior design or enterprise projects, independent new ventures or early stage business incubators.

Credits: 3.0

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

Semesters Offered: Fall

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

Pre-Requisite(s): BUS 1100 and BUS 2300 and ACC 2000 and ACC 2100 and BUS 2200 and MGT 2000 and MIS 2000 and FIN 3000 and OSM 3000 and MGT 3000 or MKT 3000

BUS 4992 - Business Development Experience II

Completion and presentation of the business plan and recommendations on the commercial viability of intellectual properties, senior design or enterprise projects, independent new ventures, or early stage incubators.

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): BUS 4991

Civil & Environmental Engineering**CEE 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

CEE 1001 - Sustainability and Civil Engineering Practice

Course will focus on characterizing the motivation for and principles of sustainable engineering and provide an introduction to tools used in sustainable design. Course topics follow a logical and linear progression which includes the societal context, scientific motivation, and application of sustainable practices in civil engineering.

Credits: 1.0

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

Semesters Offered: Spring

CEE 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

CEE 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

CEE 3202 - Structural Analysis

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

Credits: 3.0

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

Semesters Offered: Fall, Spring, Summer

Pre-Requisite(s): (ENG 2120 or MEEM 2150) and (MA 2320 or MA 2321 or MA 2330)

CEE 3331 - Professional Practice

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

Credits: 2.0

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

Semesters Offered: Fall, Spring

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

CEE 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

CEE 3401 - Transportation Engineering

Introduction to transportation in the United States, transportation mode characteristics and applications, highway geometrics and design standards, pavement design and management.

Credits: 3.0

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

Semesters Offered: Fall, Spring

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

CEE 3490 - Introduction to Rail Transportation

Introduction to topics related to rail transportation and industry. Overview of North American passenger and freight railroads in the past and today, system components (railroad track, rolling stock, and signals/communications), organizations, careers and safety, and technology and sustainability.

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

CEE 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)

CEE 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)

CEE 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)

CEE 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, Summer

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

Pre-Requisite(s): ENG 3200 and (MA 3710(C) or ENVE 3502(C) or CE 3710(C) or CEE 3502(C) or CEE 3710(C))

CEE 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

CEE 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 and (MEEM 2150 or ENG 2120) and ENG 3200

CEE 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

CEE 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 road 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): CE 3332 or CE 3401 or CEE 3332 or CEE 3401(C)

CEE 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 or CEE 3101

CEE 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 3202 or CEE 3202

CEE 4213 - Structural Concrete Design

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

Credits: 4.0

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

Semesters Offered: Spring

Pre-Requisite(s): CE 3202 or CEE 3202

CEE 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: (0-3-0)

Semesters Offered: Fall, Summer

Pre-Requisite(s): CE 3202 or CEE 3202

CEE 4233 - Structural Timber Design

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

Credits: 3.0

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

Semesters Offered: Spring

Pre-Requisite(s): CE 3202 or CEE 3202

CEE 4244 - Loads for Civil Structures

The course focuses on the theory and building code requirements for civil structural loadings that are used in design. The loads and load combinations will include dead loads, occupancy live loads, snow loads, wind loads, and seismic loads.

Credits: 3.0

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

Semesters Offered: Spring

Pre-Requisite(s): CE 3202 or CEE 3202

CEE 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 or CEE 3332 or CMG 3265

CEE 4344 - Construction Scheduling

This course will introduce students to the basics of construction scheduling. Topics covered will include: Fundamentals of different scheduling methods such as Critical Path Method and linear scheduling, Resource allocation in schedules, and Schedule monitoring and control methods.

Credits: 3.0

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

Semesters Offered: Spring

Pre-Requisite(s): CE 3332 or CMG 3265 or CEE 3332

CEE 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

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

Pre-Requisite(s): (CE 3401 or CEE 3401) and (CE 3101 or CEE 3101)

CEE 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

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

CEE 4404 - Railroad Engineering

Rail transportation systems require infrastructure, vehicles, motive power and energy, and control systems to move goods and people. This multi-disciplinary course provides students with understanding of these system components and related engineering and technology enabling efficient operation of today's system.

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): CEE 3490 or CE 4490

CEE 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: Spring

CEE 4407 - Transportation Design

Introduction to computer aided geometric design of highways and railways. Covers design principles and use of standards for horizontal and vertical alignments and cross sections, including road intersections, railway turnouts and grade crossings. Students develop engineering drawings and related cost estimates for road/rail project.

Credits: 4.0

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

Semesters Offered: Spring

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

Pre-Requisite(s): (CE 3401 or CEE 3401) and SU 2000

CEE 4410 - Transportation Planning

An introduction to urban transportation planning, planning data collection, transportation planning models, and development and evaluation of transportation plans. Includes extensive use of transportation planning software to evaluate transportation plans in multimodal networks.

Credits: 3.0

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

Semesters Offered: Fall

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

CEE 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.

Credits: 4.0

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

Semesters Offered: Fall

Pre-Requisite(s): (ENVE 3501 or CEE 3501 or ENVE 3503 or CEE 3503) and (ENVE 3502 or CEE 3502) and ENG 3200

CEE 4502 - Wastewater Treatment Principles and Design

Principles of physical, chemical, and biological processes employed in wastewater treatment. Design of selected individual units within wastewater treatment systems.

Credits: 3.0

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

Semesters Offered: Fall

Pre-Requisite(s): ENVE 3501 or CEE 3501 or ENVE 3503 or CEE 3503

CEE 4503 - Drinking Water Treatment Principles and Design

Provides an overview of the principles and design of municipal water treatment practices. Understand the physical and chemical processes employed in water treatment. Design individual unit processes with a view toward integration into complete treatment systems.

Credits: 3.0

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

Semesters Offered: Spring

Pre-Requisite(s): ENVE 3501 or ENVE 3503 or CEE 3501 or CEE 3503

CEE 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 or CEE 3501 or CEE 3503

CEE 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 or CEE 3501 or CEE 3503

CEE 4506 - Application of Sustainability Principles to Engineering Practice

Study of sustainability, engineering and design including systems analysis, life cycle analysis, biogeochemical cycles, energy balances, energy conservation and development, models for sustainable engineering, environmental regulations as sustainability instruments, sustainability in the build environment, and industrial ecology and compliance.

Credits: 3.0

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

Semesters Offered: Spring

Pre-Requisite(s): ENVE 3501 or ENVE 3503 or CEE 3501 or CEE 3503

CEE 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 CEE 3501 or ENVE 3503 or CEE 3503) and (CE 3620 or CEE 3620)

CEE 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 CEE 3501 or ENVE 3503 or CEE 3503) and ENG 3200 and (ENVE 4502 or CEE 4502 and ENVE 4503 or CEE 4503)

CEE 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

CEE 4511 - Solid and Hazardous Waste Engineering

Characterization, treatment, separation, and disposal of solid and hazardous wastes. Science and engineering for the management of solid and hazardous waste problems. Technologies discussed include incineration, landfilling, vapor extraction, soil washing, and bioremediation.

Credits: 3.0

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

Semesters Offered: Spring

Pre-Requisite(s): ENVE 3501 or CEE 3501 or ENVE 3503 or CEE 3503

CEE 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 or CEE 4504 or ENVE 4501 or CEE 4501 or CH 3510

CEE 4518 - Aquatic Biogeochemistry

Covers interactions among chemical, biological, and physical processes within aquatic ecosystems as well as role of aquatic ecosystems in global biogeochemistry. Modeling as an integrative tool is stressed.

Credits: 3.0

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

Semesters Offered: Fall - Offered alternate years beginning with the 2014-2015 academic year

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

Pre-Requisite(s): (ENVE 4501(C) or CEE 4501(C)) and (ENVE 4505(C) or CEE 4505(C))

CEE 4528 - Global Biogeochemistry

This course gives an overview of important biogeochemical processes occurring in land, air, and water. An emphasis is put on modeling as an integrating tool.

Credits: 3.0

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

Semesters Offered: Fall - Offered alternate years beginning with the 2015-2016 academic year

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

Pre-Requisite(s): ENVE 4501(C) or CEE 4501(C)

CEE 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 or CEE 3620

CEE 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: Summer

Pre-Requisite(s): CE 3620 or CEE 3620

CEE 4665 - Stream Restoration

Basic mechanics of the transport of sediments in natural systems, including tractive forces and geomorphic functions.

Credits: 3.0

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

Semesters Offered: Spring

Pre-Requisite(s): CE 3620 or CEE 3620

CEE 4760 - Optimization Methods in Civil and Environmental Engineering

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

Credits: 3.0

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

Semesters Offered: Spring

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

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

CEE 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 or CEE 3810

CEE 4830 - Geosynthetics Engineering

Geosynthetic materials are grouped by mechanical characteristics and engineering use. They are widely used in highway, landfill, and bankment 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 or CEE 3810

CEE 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 or CEE 3810

CEE 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

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

CEE 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 or CEE 4900

CEE 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

CEE 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 or CEE 4915

CEE 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

CEE 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

CEE 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

CEE 4993 - Engineering with Developing Communities

Study of applying appropriate, community-based, and sustainable engineering in developing communities. Concepts of human-centered design and sustainable development are covered. Topics are drawn from several areas of engineering, including water and wastewater treatment, construction materials, solid waste, energy, and information systems.

Credits: 2.0

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

Semesters Offered: On Demand

Pre-Requisite(s): (ENG 2120 or MEEM 2150) and (CE 3620 or CEE 3620)

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 0200 - Organic Chemistry Coaching

Scheduled weekly individual or study group session with an experienced organic chemistry coach to improve understanding of organic structures, develop skills for predicting products of organic reactions, the drawing of mechanisms and determining synthesis strategies as well as awareness of expectations in a specific discipline of chemistry.

Credits: 0.0; May be repeated

Semesters Offered: Fall, Spring

CH 1000 - Introductory Chemistry

Introduces fundamental concepts of chemistry to students who are interested in how chemical processes shape the world. Covers fundamental chemical concepts and integrates applications of chemistry that are relevant to the global community. High school chemistry is not required.

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(C) or MA 1032(C)

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 - Professional Development for Chemists I: Orientation

Required for all entering chemistry majors. Intro to department, cover writing, technical software, library resources, reading and writing reports, academic integrity, career services, and other orientation topics. First course in a four-part professional development sequence.

Credits: 1.0; Graded Pass/Fail Only

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

Semesters Offered: Fall

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

CH 1150 - University Chemistry I

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

Credits: 3.0

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

Semesters Offered: Fall, Spring, Summer

Co-Requisite(s): CH 1151

Pre-Requisite(s): MA 1031(C) or MA 1032(C) or MA 1160(C) or MA 1161(C) or MA 1135(C) or ALEKS Math Placement \geq 56 or CEEB Calculus AB \geq 2 or CEEB Calculus BC \geq 2 or CEEB Calculus AB Subscore \geq 2

CH 1151 - University Chemistry Lab I

Laboratory to accompany CH1150.

Credits: 1.0

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

Semesters Offered: Fall, Spring, Summer

Co-Requisite(s): CH 1150

Pre-Requisite(s): MA 1031(C) or MA 1032(C) or MA 1160(C) or MA 1161(C) or MA 1135(C) or ALEKS Math Placement \geq 56 or CEEB Calculus AB \geq 2 or CEEB Calculus BC \geq 2 or CEEB Calculus AB Subscore \geq 2

CH 1153 - University Chem Recitation I

Problem solving session to support University Chemistry I - CH1150.

Credits: 1.0

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

Semesters Offered: Fall, Spring, Summer

Co-Requisite(s): CH 1150

Pre-Requisite(s): MA 1031(C) or MA 1032(C) or MA 1160(C) or MA 1161(C) or MA 1135(C) or ALEKS Math Placement \geq 56 or CEEB Calculus AB \geq 2 or CEEB Calculus BC \geq 2 or CEEB Calculus AB Subscore \geq 2

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

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 2130 - Professional Development for Chemists 2: Career Planning

Continuation from CH1130 and provides a more in-depth review of topics related to career planning, such as resume writing, interviewing, selecting research topics, research integrity, reading and writing reports, applying for scholarships and grants, and oral communication skills.

Credits: 2.0

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

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): CH 1130

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, mass spectrometry and infrared 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

Covers more functional group chemistry based on reaction mechanisms; more involved multi-step synthesis; introduction to nuclear magnetic resonance spectroscopy; 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 3130 - Professional Development for Chemists 3: Communication

Continuation from CH2130 and provides a more in-depth review of topics related to refining written and oral communication skills, including advanced library resources, reading and writing reports, and seminar attendance.

Credits: 1.0

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

Semesters Offered: Spring

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

Pre-Requisite(s): CH 2130

CH 3510 - Physical Chemistry I - Thermodynamics, Equilibrium and Kinetics

Ideal and non-ideal gas laws, the kinetic theory of gases, equations of state, liquid-vapor equilibrium, the laws of thermodynamics, solid-liquid-vapor equilibria, the chemical potential, chemical equilibrium, electrochemistry, the phase rule, phase diagrams, and chemical kinetics.

Credits: 3.0

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

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 4130 - Professional Development for Chemists 4: Senior Seminar

Continuation from CH3130 with emphasis on advanced topics of written and oral communication skills.

Credits: 2.0

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

Semesters Offered: Spring

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

Pre-Requisite(s): CH 3130

CH 4140 - Introduction to Pharmaceutical Analysis

This course will present a systematic introduction to chemical analysis of pharmaceutical raw materials, finished pharmaceutical products, and of drugs in biological fluids, which are carried out in pharmaceutical laboratories worldwide.

Credits: 3.0

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

Semesters Offered: Spring

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

Pre-Requisite(s): CH 2410

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

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 4240 - Advanced Mass Spectrometry

Advanced instrumentation and methods are the focus of this course. Design of various mass analyzers and their advantages and limitations will be reviewed. Advanced identification methods such as tandem mass spectrometric analysis and exact mass analysis will be discussed.

Credits: 3.0

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

Semesters Offered: Spring - Offered alternate years beginning with the 2019-2020 academic year

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

Co-Requisite(s): CH 4241

Pre-Requisite(s): CH 4212 or CH 4222

CH 4241 - Advanced Mass Spectrometry Laboratory

Students will learn how to perform mass spectrometry (MS) experiments to identify and quantify molecules. The experiments will include the following method approaches: electrospray ionization (ESI), matrix associated laser desorption (MALDI) and tandem MA analysis (MS/MS).

Credits: 1.0

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

Semesters Offered: Spring - Offered alternate years beginning with the 2019-2020 academic year

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

Co-Requisite(s): CH 4240

Pre-Requisite(s): CH 4212 or CH 4222

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 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.

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 4515 - Atmospheric Chemistry

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

Credits: 3.0

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

Semesters Offered: Spring

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

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

CH 4516 - Aerosol and Cloud Chemistry

This course is focused on the chemistry of atmospheric aerosols and cloud processes. Students will learn about methods for chemical characterization, the chemical composition of aerosol and the chemical reactions pertinent to secondary aerosol and cloud composition.

Credits: 3.0

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

Semesters Offered: Spring - Offered alternate years beginning with the 2019-2020 academic year

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

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

CH 4519 - Transport and Transformation of Organic Pollutants

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

Credits: 3.0

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

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

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

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

CH 4535 - Physical Chemistry III - Molecular Driving Forces from Fundamentals to Applications

Advance course design to bridge concepts in thermodynamics, kinetics, and quantum chemistry through the application of statistical mechanics to understand the molecular driving forces acting in chemical/physical/material/biological systems at both microscopic, and macroscopic level.

Credits: 3.0

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

Semesters Offered: Fall - Offered alternate years beginning with the 2017-2018 academic year

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

Pre-Requisite(s): CH 3510 and CH 3520

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: 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) or BE 4300(C) or MY 4600(C) or MSE 4110(C)

CH 4640 - Synthesis of Nanoparticles

This hands-on course teaches methods of preparing different types of nanoparticles, and controlling nanoparticle size, structure, and functionalization. Students will analyze selected papers from professional literature to see emerging trends in nanoparticle design and use.

Credits: 3.0

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

Semesters Offered: Fall

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

Pre-Requisite(s): CH 2410 and CH 2411

CH 4690 - Current Topics in Polymer Chemistry

Discussion of current topics in polymer chemistry.

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

Semesters Offered: On Demand

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

CH 4710 - Biomolecular Chemistry I

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

Credits: 3.0

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

Semesters Offered: Fall, Summer

Pre-Requisite(s): CH 2420

CH 4720 - Biomolecular Chemistry II

Focuses on structural and chemical logic of bioprocesses with emphasis on 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 and CH 4720(C)

CH 4730 - Confocal Laser Scanning Microscopy: Foundations, Applications, and Advances

Principles of fluorescence microscopy, confocal microscope design, practical aspects of confocal microscopy, live cell imaging, high speed imaging, fluorescent stains, quantitative fluorescence, immunofluorescence, fluorescent proteins, biosensors. Confocal applications in biology and health related sciences will be covered.

Credits: 1.0

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

Semesters Offered: Fall, Summer

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

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 instructor 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. Must be accepted into the Secondary Education Program.

Credits: 2.0

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

Semesters Offered: Spring - Offered alternate years beginning with the 2013-2014 academic year

Restrictions: Must be enrolled in one of the following Major(s): Secondary Education

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

CH 4990 - Undergraduate Research in Chemistry

An undergraduate research experience in which students select a literature and laboratory research problem and write a report on the work performed. The student typically signs up for 1 to 3 credits per semester; most problems require more than one semester to complete. Requires GPA of 2.50 or better.

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

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required

CH 4995 - Undergrad Research in Biochem

Undergraduate research experience in Biochemistry where students work on independent research projects under the direction of biochemistry faculty performing research in areas of biophysics, 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 1000 - Introduction to Chemical Engineering**

Introduces chemical engineering as a profession using the theme of industrial chemical production. Covered concepts include process flow diagrams, unit operations, green engineering, and career opportunities. Guest speakers from industry will provide their perspectives on working as a chemical engineer.

Credits: 1.0

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

Semesters Offered: Fall

CM 2110 - Fund of Chem Engg 1

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

Credits: 3.0

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

Semesters Offered: Fall, Summer

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

CM 2120 - Fund of Chem Engg 2

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

Credits: 3.0

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

Semesters Offered: Spring, Summer

Pre-Requisite(s): CM 2110

CM 2200 - Intro Minerals and Materials

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

Credits: 3.0

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

Semesters Offered: Fall

CM 3110 - Transport/Unit Operations 1

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

Credits: 3.0

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

Semesters Offered: Fall, Spring

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

CM 3120 - Transport/Unit Operations 2

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

Credits: 3.0

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

Semesters Offered: Spring

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

Pre-Requisite(s): CM 3110 and CM 2120 and (MA 3520 or MA 3521 or MA 3530 or MA 3560)

CM 3215 - Transport Laboratory

This course will be an introduction to basic laboratory methods and instrumentation used in the measurement of fluid flow, heat transfer, and mass transfer. Topics to be covered include methods of statistical data analysis, experimental design, principles of measurement and instrumentation, and technical communication.

Credits: 3.0

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

Semesters Offered: Fall, Spring

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

Pre-Requisite(s): CM 2120 and CM 3110(C) and (MA 3520 or MA 3521 or MA 3530 or MA 3560) and UN1015

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

Pre-Requisite(s): CH 3510 and MA 3160 and (MA 3520(C) or MA 3521(C) or MA 3530(C) or MA 3560(C))

CM 3310 - Process Control

Covers methods of analyzing the transient behavior of chemical processing systems. Develops methods of analyzing systems and system components along with the special mathematical techniques needed. These concepts are then applied to illustrate mathematical modeling of large-scale chemical processing systems.

Credits: 3.0

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

Semesters Offered: Spring

Pre-Requisite(s): (MA 3520 or MA 3521 or MA 3530 or MA 3560) and PH 2200 and CM 2110 and CM 2120

CM 3410 - Technical Communication for Chemical Engineering

Study of the purposes, genres, and applications of technical communication in chemical engineering professions, including written, oral, visual, and graphic communication. Assignments may include memos, progress reports, procedures, memo and formal reports, research citations, and job-seeking requirements. Emphasizes organization, support, coherence, usefulness, ethics, and professionalism.

Credits: 3.0

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

Semesters Offered: Fall, Spring, Summer

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

Pre-Requisite(s): UN 1015

CM 3450 - Computer-Aided Problem Solving in Chemical Engineering

The use of modern software packages in chemical engineering. Packages include spreadsheet, symbolic manipulator, chemical process calculator, statistical and modeling software. Course develops knowledge and skills in using computer tools that will complement chemical engineering courses and practice.

Credits: 3.0

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

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

Pre-Requisite(s): CM 2110(C) and MA 2160

CM 3510 - Chemical Reaction Engineering

A study of chemical reaction engineering including design and analysis of chemical reactors, the fundamentals of chemical kinetics, and analysis of reaction rate data.

Credits: 3.0

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

Semesters Offered: Spring

Pre-Requisite(s): CM 2110 and CM 3110 and CM 3230(C) and (MA 3520 or MA 3521 or MA 3530 or MA 3560) and CH 2410

CM 3825 - Sampling, Statistics, and Instrumentation

Solids sampling theory, practice, and instrumentation for process streams. Statistics/probability as they apply to representative samples from bulk lots. Minimization of errors, proper design of sample collection and size reduction apparatus, and statistical design and analysis will be covered.

Credits: 2.0

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

Semesters Offered: Spring - Offered alternate years beginning with the 2016-2017 academic year

CM 3830 - Mineral Processing and Extraction Laboratory

Laboratory course covering the major mineral processing and extractive metallurgy operations, such as crushing, grinding, sampling, particulate separation processes, dewatering, and hydrometallurgical processing.

Credits: 1.0

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

Semesters Offered: Spring

Pre-Requisite(s): CM 2200(C) or CM 2110(C)

CM 3979 - Alternative Energy Technologies and Processes

This course covers a wide range of alternative energy technologies with an emphasis on chemical and biochemical processing. Technologies covered may include biofuels, solar power, fuel cells, etc.

Credits: 1.0

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

Semesters Offered: Fall

Pre-Requisite(s): CH 1112 or (CH 1150 and CH 1151) and (MA 1160 or MA 1161)

CM 4000 - Chemical Engineering Research

An undergraduate research experience on chemical engineering topics. Students work directly with faculty members on a research project. A report (written, poster, or oral) may be required.

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

Semesters Offered: Fall, Spring, Summer

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

CM 4020 - Undergraduate Research in Mineral Processing Engineering

An undergraduate research experience on mineral processing engineering topics. Students work directly with faculty members on a research project. A report (written, poster, or oral) may be required.

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

Semesters Offered: Fall, Spring, Summer

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

CM 4040 - Undergraduate Research in Biological Engineering

An undergraduate research experience on biological engineering topics, excluding biofuels. Students work directly with faculty members on a research project. A report (written, poster, or oral) may be required.

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

Semesters Offered: Fall, Spring, Summer

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

CM 4060 - Undergraduate Research in Polymer Engineering

An undergraduate research experience on polymer engineering topics. Students work directly with faculty members on a research project. A report (written, poster, or oral) may be required.

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

Semesters Offered: Fall, Spring, Summer

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

CM 4080 - Undergraduate Research in BioFuels Engineering

An undergraduate research experience on bio-fuels engineering topics. Students work directly with faculty members on a research project. A report (written, poster, or oral) may be required.

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

Semesters Offered: Fall, Spring, Summer

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

CM 4110 - Unit Operations Laboratory

Provides a rigorous introduction to experiments focused in the unit operations of fluid mechanics, heat transfer, mass transfer, and chemical reaction engineering.

Credits: 3.0

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

Semesters Offered: Fall

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

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

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

CM 4120 - Chemical Plant Operations Lab

A capstone laboratory course focused on chemical manufacturing processes using the department's pilot plants. Safety, process control, teamwork, and communication skills are stressed.

Credits: 3.0

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

Semesters Offered: Spring

Restrictions: May not be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Chemical Engineering

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

CM 4125 - Bioprocess Engineering Laboratory

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

Credits: 1.0

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

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

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

CM 4310 - Chemical Process Safety/Env

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

Credits: 3.0

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

Semesters Offered: Fall

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

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

CM 4505 - 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. Covers zeta potential, particulate surface chemistry, flocculation, and dispersion.

Credits: 3.0

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

Semesters Offered: Spring - Offered alternate years beginning with the 2017-2018 academic year

CM 4510 - Interfacial Engineering

Examines the physics and chemistry of interfaces, and the relevance of these principles in mineral processing, petroleum, water treatment, and other engineering applications. May include liquid surfaces, electric double layer, surface forces, contact angle phenomena, surfactants, adsorption, surface energy, emulsions.

Credits: 3.0

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

Semesters Offered: Spring - Offered alternate years beginning with the 2018-2019 academic year

Pre-Requisite(s): CH 3510

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: Spring

Pre-Requisite(s): CH 2420

CM 4631 - Polymer Science Laboratory

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

Credits: 2.0

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

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

Pre-Requisite(s): CM 4610(C) or CH 4610(C) or BE 4300(C) or MY 4600(C) or MSE 4110(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 - Offered alternate years beginning with the 2016-2017 academic year

Pre-Requisite(s): (CM 3110 or MEEM 3210 or ENG 3200 or MY 3110 or MSE 3110 or CE 3600 or CEE 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 or parallel-plate) and capillary shear will be taught. Also covered will be approximate methods for obtaining elongational viscosity.

Credits: 1.0

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

Semesters Offered: Fall

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

Pre-Requisite(s): CM 4610(C) or CH 4610(C) or CM 4650(C) or BE 4300(C) or MY 4600(C) or MSE 4110(C)

CM 4710 - Biochemical Processes

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

Credits: 3.0

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

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

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

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

CM 4740 - Hydrometallurgy/Pyrometallurgy

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

Credits: 4.0

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

Semesters Offered: Spring

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

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

CM 4770 - Analytical Microdevice Technologies

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

Credits: 3.0

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

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

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

Pre-Requisite(s): PH 2200

CM 4780 - Biomanufacturing and Biosafety

This course will give students additional tools to perform as an engineer in a biomanufacturing facility. Focus is on mammalian cell culture derived products. Federal laws and compliance of biosafety in manufacturing facilities. Process design software will be introduced.

Credits: 3.0

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

Semesters Offered: Fall - Offered alternate years beginning with the 2014-2015 academic year

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

Pre-Requisite(s): BL 2100 or CH 4710 or CM 4040 or CM 4080 or CM 4710 or (CM 3110(C) and BL 1040)

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

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

Pre-Requisite(s): CM 3120 and CM3215 and CM 3230 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

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

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

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

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: variable to 3.0

Semesters Offered: Spring

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

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: 2.0

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

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 1200 - Introduction to Building Information Modeling

An introduction to Building Information Modeling (BIM) with an emphasis on the Autodesk Revit software.

Credits: 2.0

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

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(C)

CMG 2120 - Statics and Strengths of Materials for Construction

Composition and resolution of forces and force systems, principles of equilibrium applied to various bodies, simple structures, friction, centroids, and moments of inertia. Mechanical behavior of materials, including 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 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: (0-2-2)

Semesters Offered: On Demand

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

Pre-Requisite(s): CMG 3200(C)

CMG 4100 - Construction Equipment Management

Study of basic principles used in the construction industry for selecting and managing construction equipment. Focuses on understanding the time value of money, estimating equipment ownership and operating costs, selecting the proper equipment for specific tasks, and estimating equipment production.

Credits: 3.0

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

Semesters Offered: On Demand

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

Pre-Requisite(s): CMG 3265 and EC 3400

CMG 4120 - Construction Planning and Scheduling

This course will introduce students to the basics of construction scheduling. Topics covered will include: Fundamentals of different scheduling methods such as Critical Path Method and linear scheduling. Resource allocation in schedules, and Schedule monitoring and control methods.

Credits: 3.0

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

Semesters Offered: Spring

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

Pre-Requisite(s): CMG 3265 or CE 3332 or CEE 3332

CMG 4200 - Construction Contracts

Legal aspects of construction to include a study of construction documents, the project manual, report requirements, agreements, change orders, and other administrative functions in building construction.

Credits: 3.0

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

Semesters Offered: Spring

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

Pre-Requisite(s): BUS 2200

CMG 4210 - Construction Project Management

Provides students with an understanding of the principles required to deliver a construction project on time, within budget, and with acceptable quality. Topics include construction law, contracts, delivery systems, 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): 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 semester-long simulated construction projects (commercial and 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

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 1040 - Assembly Language Programming

Programming in assembly language. Includes integer floating point, and instruction encoding in binary. Transition course for only those students affected by credit change in CS1141/3421.

Credits: 1.0

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

Semesters Offered: Fall, Spring, Summer

Pre-Requisite(s): CS 1122 or CS 1131

CS 1090 - Special Topics in Computer Science

Special topics in computer science offered on occasion based on student and faculty demand and interest.

Credits: variable to 3.0; May be repeated

Semesters Offered: On Demand

Restrictions: Permission of instructor required

CS 1111 - Introduction to Programming in C/C++

Introductory course in C/C++ programming. Topics include top-down analysis of problems, structured programming, control structures, functions, arrays, pointers, and file I/O. Basic concepts of object-oriented programming (classes, objects, function overloading) will also be introduced.

Credits: 3.0

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

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Major(s): Industrial Technology, Computer Network & System Admn, Electrical Engineering, Audio Production & Technology; Must be enrolled in one of the following Class(es): Freshman, Sophomore

CS 1121 - Introduction to Programming I

Starting point of the computer science programs. A high-level, object-oriented programming language is introduced as a problem-solving tool. Topics include design, coding, documentation, debugging, and testing of programs. Programming assignments are given in both a closed lab setting and as homework.

Credits: 3.0

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

Semesters Offered: Fall, Spring, Summer

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

CS 1122 - Introduction to Programming II

Continuation of CS 1121. Topics include data abstraction, class hierarchies and polymorphism, list, stack, queue and tree data structures, complexity-based algorithm and data structure choices, and recursion. Homework programming assignments are given.

Credits: 3.0

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

Semesters Offered: Fall, Spring, Summer

Pre-Requisite(s): CS 1121

CS 1131 - Accelerated Introduction to Programming

An alternative starting point of the computer science programs for students with some programming experience, combining material from CS1121 and CS1122, offered at an accelerated pace. Homework programming assignments are given.

Credits: 5.0

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

Semesters Offered: Fall

Restrictions: Permission of department required

Pre-Requisite(s): MA 1031 or MA 1032 or MA 1160(C) or MA 1161(C)

CS 1142 - Programming at the Hardware Software Interface

Programming in assembly language and C for students with prior experience in Java. Topics include binary number encodings, instruction set architecture, assembly language programming, and instruction encodings. C programming topics include program structure, preprocessor, arrays, structures, pointers, input/output, dynamic memory management, and linked data structures.

Credits: 3.0

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

Semesters Offered: Fall, Spring, Summer

Pre-Requisite(s): CS 1122 or CS 1131

CS 2090 - Special Topics in Computer Science

Special topics in computer science offered on occasion based on student and faculty demand and interest.

Credits: variable to 3.0; May be repeated

Semesters Offered: On Demand

Restrictions: Permission of instructor required

CS 2311 - Discrete Structures

Presents fundamental concepts in discrete structures that are used in computer science. Topics include sets, trees, graphs, functions, relations, recurrences, proof techniques, logic, combinatorics, and probability.

Credits: 3.0

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

Semesters Offered: Fall, Spring, Summer

Pre-Requisite(s): (CS 1121 or CS 1131) and (MA 1135 or MA 1160 or MA 1161)

CS 2321 - Data Structures

Presents fundamental concepts in data structures. Topics include abstract data types (priority queues, dictionaries and graphs) and their implementations, algorithm analysis, sorting, text processing, and object oriented design. A significant programming project is assigned.

Credits: 3.0

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

Semesters Offered: Fall, Spring, Summer

Pre-Requisite(s): CS 1122 or CS 1131

CS 3000 - Ethical and Social Aspects of Computing

An examination of social and ethical issues associated with computing. Topics include: ethical theories and decision making, intellectual property, freedom of expression, privacy, security, and professional responsibility.

Credits: 2.0

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

Semesters Offered: Fall, Spring

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

Pre-Requisite(s): CS 3141

CS 3090 - Special Topics in Computer Science

Special topics in computer science offered on occasion based on student and faculty demand and interest.

Credits: variable to 3.0; May be repeated

Semesters Offered: On Demand

Restrictions: Permission of instructor required

CS 3141 - Team Software Project

This course introduces software design techniques (e.g., Design-By-Contracts), uses the UML for requirements and design specification, and requires implementation, unit testing and documentation in the context of a significant team project. Other topics: teamwork, user interfaces, social and professional responsibility.

Credits: 3.0

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

Semesters Offered: Fall, Spring

Pre-Requisite(s): (CS 2311 or MA 3210) and CS 2321

CS 3311 - Formal Models of Computation

Introduction to the theory of formal languages and computation. Topics include regular languages and finite automata, context-free languages and push-down automata, Turing-acceptable languages, Turing machines and the halting problem. Proof techniques and applications, such as parsing, are also treated.

Credits: 3.0

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

Semesters Offered: Fall, Spring, Summer

Pre-Requisite(s): CS 2311 or MA 3210

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 1142 or (CS 1141 and CS 1040) and (CS 2311 or MA 3210) and CS 2321

CS 3411 - Systems Programming

Development of robust programs that provide efficient services to system software developers. Topics include: file I/O, process creation and management, linking and libraries, interprocess communication, performance measurement, and socket programming.

Credits: 3.0

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

Semesters Offered: Fall, Spring, Summer

Pre-Requisite(s): CS 3421

CS 3421 - Computer Organization

Introduction to the logical structure of computers, including the fundamentals of logic design, information storage and manipulation, control, and input/output. 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: 3.0

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

Semesters Offered: Fall, Spring, Summer

Pre-Requisite(s): (CS 1141 and CS 1040) or CS 1142

CS 3425 - Introduction to Database Systems

This course provides an introduction to database systems including database design, query, and programming. Topics include goals of database management; data definition; data models; data normalization; data retrieval and manipulation with relational algebra and SQL; data security and integrity; database and Web programming; and languages for representing semi-structured data.

Credits: 3.0

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

Semesters Offered: Fall, Spring

Pre-Requisite(s): (CS 2311 or MA 3210) and CS 2321

CS 3712 - Software Quality Assurance

Practices for ensuring quality through the software process. Topics include: requirements elicitation, analysis and documentation, testing, and quality assurance management.

Credits: 3.0

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

Semesters Offered: Spring

Pre-Requisite(s): CS 3141

CS 4090 - Special Topics in Computer Science

Special topics in computer science offered on occasion based on student and faculty demand and interest.

Credits: variable to 4.0; May be repeated

Semesters Offered: On Demand

Restrictions: Permission of instructor required

CS 4099 - Directed Study in Computer Science

Students study one or more special topics in computer science under the direction of one or more faculty members.

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

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required

CS 4121 - Programming Languages

A discussion of the concepts underlying programming languages. Topics include programming paradigms; language properties (including syntax, semantics, run-time behavior, and implementation issues); data, procedure, functional, and control abstraction; functional programming; and logic programming.

Credits: 3.0

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

Semesters Offered: Fall, Spring

Pre-Requisite(s): CS 2321 and CS 3421 and CS 3311

CS 4130 - Compiler Design and Optimization

Design, theory, and programming language translators and the theory and implementation of optimizers. Topics include: intermediate representations, advanced code generation, control-and data-flow analysis, advanced compiler optimization, dynamic compilation, global register allocation and instruction scheduling.

Credits: 3.0

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

Semesters Offered: Fall, Spring

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

Pre-Requisite(s): 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 or MA 3210) and CS 2321

CS 4411 - Operating Systems

Principles of the design and implementation of operating systems. Topics include: process management, process scheduling, memory management, I/O, file systems. Includes a significant implementation component.

Credits: 3.0

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

Semesters Offered: Spring

Pre-Requisite(s): CS 3331 and CS 3421

CS 4425 - Database Management System Design

This course covers the design issues concerning the implementation of database management systems, including distributed databases. The topics include data storage, index implementation, query processing and optimization, security, concurrency control, transaction processing, and recovery.

Credits: 3.0

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

Semesters Offered: On Demand

Pre-Requisite(s): CS 3425

CS 4431 - Computer Architecture

Advanced course in architecture of high-performance computer systems. Topics include instruction-set design, simulation of processor architectures, multiple functional units, pipelining, dynamically scheduled pipelines, speculative execution, multi-core and multi-processor systems, advanced I/O subsystems and analytic models of architectural features of processors.

Credits: 3.0

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

Semesters Offered: Fall, Spring

Pre-Requisite(s): CS 3421

CS 4461 - Computer Networks

Computer network architectures and protocols; design and implementation of datalink, network, and transport layer functions. Introduction to the Internet protocol suite (TCP, UDP, IP), domain name service and protocols, file sharing protocols, wireless networks, and network security.

Credits: 3.0

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

Semesters Offered: Fall, Spring

Pre-Requisite(s): CS 3411

CS 4471 - Computer Security

Development and administration of secure software systems. Topics include principles of software development, practical cryptography, program security, operating system security, database security, administration, legal and ethical issues.

Credits: 3.0

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

Semesters Offered: Fall

Restrictions: May not be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): CS 3411 or CS 4411

CS 4496 - GPU and Multicore Programming

Introduction to Graphics Processing Units (GPU) and multi-core systems, their architectural features and programming models, stream programming and compute unified driver architecture (CUDA), caching architectures, linear and non-linear programming, scientific computing on GPUs, sorting and search, stream mining, cryptography, and fixed and floating point operations.

Credits: 3.0

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

Semesters Offered: Fall

Restrictions: May not be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): CS 3411 and CS 3421

CS 4611 - Computer Graphics

Introduction to interactive computer graphics. Topics include 3D viewing, 3D transformation, interactive techniques, animation, modeling, lighting, texturing, vertex programs, fragment programs, and graphics algorithms. Requires substantial programming homework.

Credits: 3.0

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

Semesters Offered: Fall

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

Pre-Requisite(s): (CS 1141 or CS 1142) 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: Spring, Summer

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: Fall

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: Fall, Spring

Restrictions: Permission of instructor required

Pre-Requisite(s): CS 3712 or CS 4760

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

CS 4821 - Data Mining

Data mining focuses on extracting knowledge from large data sources. The course covers data mining concepts, methodology (measurement, evaluation, visualization, etc.), algorithms (classification/regression, clustering, association rules, etc.), and applications (web mining, recommender systems, bioinformatics, etc.).

Credits: 3.0

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

Semesters Offered: Spring

Restrictions: Permission of instructor required

Pre-Requisite(s): (CS 3425 or MIS 3100) and (MA 2330 or MA 2320 or MA 2321) and (MA 2710 or MA 2720 or MA 3710)

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

Pre-Requisite(s): MA 1020 or MA 1031 or MA 1032 or MA 1135(C) or MA 1160(C) or MA 1161(C)

EC 3002 - Microeconomic Theory

The study of consumer and producer choices, market demand and supply, and market structures.

Credits: 3.0

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

Semesters Offered: Spring

Pre-Requisite(s): EC 2001 and (MA 1135 or MA 1160 or MA 1161) and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

EC 3003 - Macroeconomic Theory

Analysis of the determinants of the level of output, employment, prices, and economic growth with an emphasis on fiscal policy and monetary policy.

Credits: 3.0

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

Semesters Offered: Fall

Pre-Requisite(s): EC 2001 and (MA 1135 or MA 1160 or MA 1161) and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

EC 3100 - International Economics

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

Credits: 3.0

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

Semesters Offered: Fall, Spring, Summer

Pre-Requisite(s): EC 2001 and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

EC 3300 - Industrial Organization

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

Credits: 3.0

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

Semesters Offered: Fall, Spring

Pre-Requisite(s): EC 2001 and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

EC 3400 - Economic Decision Analysis

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

Credits: 3.0

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

Semesters Offered: Fall, Spring, Summer

Restrictions: May not be enrolled in one of the following Major(s): Finance, Operations and Systems Mgmt, Management Information Systems, Marketing, Accounting, Management; May not be enrolled in one of the following Class(es): Freshman, Sophomore

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

EC 4000 - Senior Seminar in Economics

A senior capstone seminar in which students discuss and conduct research under the guidance of several faculty members.

Credits: 3.0

Lec-Rec-Lab: (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: On Demand

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

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

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: Spring

Pre-Requisite(s): (EC 3002 or 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 (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 FIN 3000) and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

EC 4500 - Public Sector 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: On Demand

Pre-Requisite(s): EC 2001 and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

EC 4620 - Energy Economics

Introduction to the institutional, technical, and economic issues of the production and use of energy resources, including petroleum, natural gas, coal, nuclear, electric utilities, and alternative energy. Coursework applies economic analysis to supply, distribution, and use of energy resources, including environmental and social consequences.

Credits: 3.0

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

Semesters Offered: Spring

Pre-Requisite(s): EC 2001 and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

EC 4630 - Mineral Industry Economics

Studies the role of minerals and metals in society and the economics of their use. Applies economic principles to examine the supply, demand, markets, and foreign trade for important minerals and metals. Examines the effect of government policies on the minerals industries. Requires a technical report.

Credits: 3.0

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

Semesters Offered: Spring - Offered alternate years beginning with the 2018-2019 academic year

Pre-Requisite(s): EC 2001 and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

EC 4640 - Natural Resource Economics

Studies the economics of nonrenewable resources (energy and minerals) and renewable resources (water, fisheries, forests and species). Discusses the economics of land use change, macroeconomic topics such as economic growth, sustainability and green accounting.

Credits: 3.0

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

Semesters Offered: Fall

Pre-Requisite(s): (EC 2001 or EC 3002 or FW 4080) and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

EC 4650 - Environmental Economics

Considers the efficient and equitable use of environmental resources, including air, water, land, wilderness and parks, wildlife and other ecological systems. Measures the benefits and costs of decreasing pollution, cleaner environment, and protecting scarce ecological resources. Addresses market failures and the economic valuation of environmental amenities.

Credits: 3.0

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

Semesters Offered: Fall

Pre-Requisite(s): (EC 2001 or EC 3002) and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

EC 4710 - Labor/Human Resource Economics

Economic analysis of labor markets and human resources. Topics include the supply and demand for labor, wage determination, human capital theory, returns to education and training, causes of wage differentials, and economic effects of discrimination.

Credits: 3.0

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

Semesters Offered: On Demand

Pre-Requisite(s): EC 2001 and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

EC 4900 - Research

Under the general guidance of a faculty member, students read, conduct research, and prepare reports and papers as required.

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

Semesters Offered: On Demand

Pre-Requisite(s): EC 2001

EC 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 2000 - Issues in American Education**

Introduction to schooling in the United States. Emphasis on history, role of education in social reproduction and transformation, laws, and the work of teaching, as these pertain to issues of social justice.

Credits: 3.0

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

Semesters Offered: Spring

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 3210 - Foundations of Education

Contemporary issues in education from historical, philosophical, sociological and legal perspectives. Emphasizes the structure/function of U.S. education as well as exceptional children, especially the handicapped and culturally different. This course is one component of the Teacher Education Early Block. Requires admission to teacher education program.

Credits: 2.0

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

Semesters Offered: Fall

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

Co-Requisite(s): ED 3410, ED 4110

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

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

Co-Requisite(s): ED 3210, ED 4110

ED 3510 - Communicating Science I

Students design hands-on presentations for K-8 students and their parents at family science nights conducted at area schools and other events in a 4-county area (off campus 4:30-9:00PM). The course highlights presentation skills, teaching techniques, learning styles, and classroom management.

Credits: 3.0

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

Semesters Offered: On Demand

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

ED 3511 - Communicating Science II

Students will make presentations in local K-8 classrooms and/or at evening family science nights conducted at area schools. Classroom lectures will highlight the rationale for interacting with schools and communities as a professional, presentation skills, effective teaching techniques, learning styles, classroom management techniques, and model hands-on learning techniques.

Credits: 1.0

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

Semesters Offered: On Demand

ED 4020 - Methods of Teaching Social Studies

Application of learning and instructional theories and practice to the teaching of social studies. Emphasis will include application of state and national education standards and relevant assessment strategies for social studies. Requires admission to the Teacher Education program by the Department of Education.

Credits: 2.0

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

Semesters Offered: On Demand

Restrictions: Permission of department required

Pre-Requisite(s): ED 4700(C)

ED 4110 - 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

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

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: Spring

Pre-Requisite(s): ED 4110 and ED 3210 and ED 3410

ED 4300 - 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.

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

Co-Requisite(s): ED 4700

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: On Demand

Restrictions: Permission of department 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: Spring

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

Co-Requisite(s): ED 4300

Pre-Requisite(s): ED 4110 and ED 3210 and ED 3410

ED 4720 - Methods of Teaching Science

Application of learning and instructional theories to the teaching of science.

Credits: 2.0

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

Semesters Offered: Fall

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

Pre-Requisite(s): ED 4700(C)

ED 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 4300 and ED 4700 and (ED 4720 or HU 4140 or SS 4020(C) or MA 4905)

Electrical & Computer Engineering**EE 1110 - Essential Mathematics for Electrical Engineering**

Review of basic trigonometry, sinusoidal signals, amplitude, frequency and phase, addition of sinusoids. Complex numbers and complex arithmetic. Real exponential functions, complex exponentials, Euler's relations, decaying sinusoids and complex exponential functions. Differentiation and integration of sinusoids and exponentials.

Credits: 1.0; Graded Pass/Fail Only

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

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Class(es): Freshman, Sophomore

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

EE 1111 - Introduction to Electrical and Computer Engineering

A half-semester course intended to provide an introduction to the profession of Electrical Engineering and Computer Engineering freshman or sophomore students. The goals of this course are to provide perspective into the various subareas within ECE and highlight the technical, professional, and ethical behavior expected of the graduate.

Credits: 1.0

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

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Major(s): Electrical Engineering, Computer Engineering; Must be enrolled in one of the following Class(es): Freshman, Sophomore

EE 2111 - Electric Circuits I

This course will cover basic electrical concepts, resistive circuits, nodal and loop analysis techniques, superposition, Thevenin and Norton equivalents, maximum power transfer, capacitance and inductance, AC steady-state analysis.

Credits: 3.0

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

Semesters Offered: Fall, Spring, Summer

Pre-Requisite(s): EE 1110(C) and MA 2160

EE 2112 - Electric Circuits II and Lab

This course will cover second order transient circuits, magnetically coupled networks, AC steady-state analysis, polyphase circuits, variable frequency network performance, and two port networks.

Credits: 4.0

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

Semesters Offered: Fall, Spring, Summer

Pre-Requisite(s): EE 1110 and EE 2111 and (MA 3520 or MA 3521 or MA 3530 or MA 3560)

EE 2174 - Digital Logic and Lab

Introduces analysis, design, and application of digital logic. Includes Boolean algebra, binary numbers, logic gates, combinational and sequential logic, storage elements and hardware-description-language based synthesis.

Credits: 4.0

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

Semesters Offered: Fall, Spring, Summer

Pre-Requisite(s): EET 2241 or EE 2241 or CS 1121 or CS 1131 or CS 1111

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 or (EE 2111 and EE 2112(C))

EE 3131 - Electronics

Covers the fundamentals of electronic devices and circuits; operational amplifiers, bipolar junction transistors, diodes, and MOSFETs.

Credits: 4.0

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

Semesters Offered: Fall, Spring, Summer

Pre-Requisite(s): EE 2112 or EE 3010

EE 3140 - Electromagnetics

Covers basic principles of engineering electromagnetics with an emphasis on Maxwell's equations.

Credits: 3.0

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

Semesters Offered: Fall, Spring

Pre-Requisite(s): PH 2200 and MA 3160 and (EE 2110 or EE 2112)

EE 3160 - Signals and Systems

Introduces the mathematical analysis of signals, systems, and control. Topics include differential equations, Fourier series, Fourier transforms, Laplace transforms, frequency response, Bode plots, state models, and an introduction to control systems.

Credits: 3.0

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

Semesters Offered: Fall, Spring, Summer

Pre-Requisite(s): (EE 2110 or EE 2112) and (MA 2320 or MA 2321 or MA 2330) and (MA 3520 or MA 3521 or MA 3530 or MA 3560)

EE 3171 - Microcontroller Applications

Introduces the concepts of microcontroller-based systems. Describes basic characteristics of microcontrollers, then goes into significant detail in the applications of a specific microcontroller. Topics include C and assembly language programming, instruction set interface, ASICs, and polled, interrupt, and DMA input/output.

Credits: 4.0

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

Semesters Offered: Fall, Spring, Summer

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

Pre-Requisite(s): (EE 2241 or CS 1121 or CS 1111) and (EE 2174 or EE 2173)

EE 3173 - Hardware/Software System Integration

Covers the integration of hardware and software into a complete working system. Includes design and construction of I/O devices for microprocessor or microcontroller-based systems, communication and bus protocols, programming in assembler language and in "C", system integration and testing. Also covers the use of FPGAs and HDL design tools.

Credits: 4.0

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

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Major(s): Electrical Engineering, Computer Engineering

Pre-Requisite(s): (EE 2304 or EE 2174) and (EE 3130 or EE 3131) and (CS 1111 or CS 1142 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

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

Pre-Requisite(s): MA 3520 or MA 3521 or MA 3530 or MA 3560

EE 3250 - Introduction to Communications Theory

Introduction to communications systems and theory; fundamentals of point-to-point communication link design and analysis; analog modulation and demodulation techniques; digital signal representation and filtering; binary data transmission.

Credits: 3.0

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

Semesters Offered: Fall, Spring, Summer

Pre-Requisite(s): EE 3131 and EE 3160 and EE 3180

EE 3261 - Control Systems

Mathematical formulation of control problems (both transfer function and state-variable descriptions); analysis of feedback control systems (stability, transient performance, steady-state error, sensitivity, etc.); analog and digital simulation; and experiments with physical systems.

Credits: 3.0

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

Semesters Offered: Fall, Spring

Pre-Requisite(s): EE 3160

EE 3290 - Photonic Material, Devices, and Applications

Light wave propagation in optical crystals and fibers, detection, and the creation of light in semiconductors.

Credits: 4.0

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

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Major(s): Electrical Engineering, Physics, Applied Physics, Physics (BA), Biomedical Engineering, Materials Science and Engrg; Must be enrolled in one of the following Class(es): Junior, Senior

Pre-Requisite(s): EE 3140 or EE 3090 or PH 2400

EE 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

Restrictions: Must be enrolled in one of the following Major(s): Electrical Engineering, Computer Engineering

Pre-Requisite(s): EE 2110 or EE 2112 or EE 3010

EE 3901 - Design Fundamentals

The design process; includes team design activities and studies project management, ethics, and professionalism.

Credits: 2.0

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

Semesters Offered: Fall, Spring

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

Pre-Requisite(s): EE 3131(C) and UN 1015

EE 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 Engineering and Performance

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 4219 - Introduction to Electric Machinery and Drives

Provides a thorough understanding of how electric machines can be used to drive loads with control of speed, torque and position. Topics include basic electro-mechanics, rotating machinery, dc machines, ac machines, power electronics and load modeling. Applications include industrial systems, hybrid/electric vehicles and electric power systems.

Credits: 3.0

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

Semesters Offered: Spring

Pre-Requisite(s): EE 2110 or EE 2112 or EE 3010

EE 4220 - Introduction to Electric Machinery and Drives Laboratory

Provides a hands on understanding of how electric machines can be used to drive loads with control of speed, torque, and position. Topics include basic electro-mechanics, rotating machineer, dc machines, ac machines, power electronics, and load modeling.

Credits: 1.0

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

Semesters Offered: Spring

Pre-Requisite(s): EE 4219(C)

EE 4221 - Power System Analysis 1

Covers power transmission line parameters and applications, symmetrical components, transformer and load representations, systems faults and protection, and the per unit system.

Credits: 3.0

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

Semesters Offered: Fall

Pre-Requisite(s): EE 3120 and (EE 2112 or EE 2110)

EE 4222 - Power System Analysis 2

Topics covered include symmetrical components; symmetrical faults; unbalanced faults; generating the bus impedance matrix and using it in fault studies; power system protection; power system operation; power system stability.

Credits: 3.0

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

Semesters Offered: Spring

Pre-Requisite(s): EE 4221

EE 4226 - Power Engineering Laboratory

A laboratory based course highlighting single phase and three phase power concepts, including: power factor, single and three phase transformer configurations, non-ideal transformers, synchronous machines, renewable energy, power flow and fault simulations, relay settings and relay testing and calibration.

Credits: 1.0

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

Semesters Offered: Spring, Summer

Restrictions: Permission of instructor required

Pre-Requisite(s): EE 4221 and EE 4222(C)

EE 4227 - Power Electronics

Fundamentals of circuits for electrical energy processing. Covers switching converter principles for dc-dc, ac-dc, and dc-ac power conversion. Other topics include harmonics, pulse-width modulation, feedback control, magnetic components and power semiconductors.

Credits: 3.0

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

Semesters Offered: Fall, Summer

Pre-Requisite(s): EE 3120 and (EE 3130(C) or EE 3131)

EE 4228 - Power Electronics Lab

Fundamentals of design, construction and control of circuits for electrical energy processing. Covers switching converter principles for dc-dc, ac-dc, and dc-ac power conversion. Other topics include harmonics, pulse-width modulation, feedback control, magnetic components and power semiconductors.

Credits: 1.0

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

Semesters Offered: Fall

Pre-Requisite(s): EE 4227(C)

EE 4231 - Physical Electronics

Device physics and physical models of the most basic solid-state device structures. Major topics include the terminal characteristics and their physical origin, device design, and device applications.

Credits: 3.0

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

Semesters Offered: Fall, Spring

Pre-Requisite(s): EE 3130 or EE 3131

EE 4232 - Electronic Applications

Study of electronic circuits under small- and large-signal conditions. Typical topics include analysis and design of power and RF amplifiers, feedback circuits, oscillators, timing circuits, and wave-shaping circuits.

Credits: 3.0

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

Semesters Offered: Spring

Pre-Requisite(s): EE 3130 or EE 3131

EE 4240 - Introduction to MEMS

Fundamentals of micromachining and microfabrication techniques, including planar thin-film process technologies, photolithographic techniques, deposition and etching techniques, and the other technologies that are central to MEMS fabrication.

Credits: 4.0

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

Semesters Offered: Fall

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

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 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 4262 - Digital and Non-linear Control

Introduction to state space analysis and design (state feedback, observers, and observer feedback); digital control system design and analysis (Z-transforms, difference equations, the discrete-time state model, and digital implementation of controllers); introduction to nonlinear systems (equilibrium states, linearization, phase plane analysis, and describing function analysis); and experiments with physical systems.

Credits: 3.0

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

Semesters Offered: Spring

Pre-Requisite(s): EE 3261

EE 4271 - VLSI Design

Design of VLSI circuits using CAD tools. Analysis of physical factors affecting performance.

Credits: 4.0

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

Semesters Offered: Fall, Summer

Pre-Requisite(s): EE 3131 and EE 2174

EE 4272 - Computer Networks

Computer network architectures and protocols; design and implementation of 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: (3-0-0)

Semesters Offered: Fall, Spring

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

Pre-Requisite(s): CS 3411

EE 4290 - Optical Communication

Fundamentals of fiber optics communications, including sources, transmission media, detectors, signal processing, and networking.

Credits: 3.0

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

Semesters Offered: Spring

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

Pre-Requisite(s): EE 3291

EE 4295 - Introduction to Propulsion Systems for Hybrid Electric Vehicles

Hybrid electric drive vehicle analysis will be developed and applied to examine the operation, integration, and design of powertrain components. Model based simulation and design is applied to determine vehicle performance measures in comparison to vehicle technical specifications. Power flows, losses, energy usage, and drive quality are examined over drive-cycles via application of these tools.

Credits: 3.0

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

Semesters Offered: Fall, Summer

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

Pre-Requisite(s): MEEM 2200 or ENG 3200

EE 4296 - Experimental Studies in Hybrid Electric Vehicles

Hands-on course examines hybrid electric vehicles from an energy perspective. Topics include powertrain architecture, vehicle testing, fuel consumption, aerodynamics and rolling resistance, engines, batteries, electric machines and power electronics. Course culminates with study of system interactions with emphasis on idle reduction and regenerative braking.

Credits: 3.0

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

Semesters Offered: Fall, Spring

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

EE 4373 - Advanced Programmable Controllers

Using Allen Bradley Micro Logix, SLC500, and PLC-5 programmable controllers, course covers structured programming, Sequential Function Charts, networking, proportional integral differential control, data acquisition and interfacing. The labs will require students to write and troubleshoot complex PLC programs.

Credits: 4.0

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

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Major(s): Electrical Engineering, Computer Engineering; Must be enrolled in one of the following Class(es): Junior, Senior

Pre-Requisite(s): EE 3373

EE 4411 - Engineering Electromagnetics

A mathematically rigorous study of dynamic electromagnetic fields, beginning with Maxwell's equations. Topics include scalar and vector potentials, waves, and radiation.

Credits: 3.0

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

Semesters Offered: Fall

Pre-Requisite(s): EE 3140

EE 4490 - Laser Systems and Applications

Survey of laser types and analysis of common physical and engineering principles, including energy states, inversion, gain, and broadening mechanism from a quantum mechanical perspective. Laser applications and laser properties are explored in the laboratory portion.

Credits: 4.0

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

Semesters Offered: Spring

Pre-Requisite(s): EE 3140

EE 4723 - Network Security

Learn fundamental of cryptography and its application to network security. Understand network security threats, security services, and countermeasures. Acquire background knowledge on well known network security protocols. Address open research issues in network security.

Credits: 3.0

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

Semesters Offered: Fall

Pre-Requisite(s): EE 4272 or CS 4461

EE 4737 - Embedded System Interfacing

Covers the use of low-power microcontrollers and hardware-dependent C for embedded sensing and control systems. Emphasizes direct interfacing with analog and digital sensors and actuators of several different modalities, to implement end-to-end embedded systems for applications including robotics and wireless sensor nets.

Credits: 4.0

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

Semesters Offered: Spring, Summer

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

Pre-Requisite(s): (CS 1141 or EE 2241) and (EE 3171 or EE 3173)

EE 4777 - Distributed Additive Manufacturing Using Open-Source 3-D Printing

This course provides an overview of open-source hardware in theory and practice for an introduction to distributed additive manufacturing using open-source 3-D printing. Each student will build a customized RepRap and will learn all hardware and software for maintaining it.

Credits: 3.0

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

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following College(s): College of Engineering; Must be enrolled in one of the following Class(es): Junior, Senior

EE 4800 - Special Topics in Electrical Engineering

Covers specific topics in electrical engineering.

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

Semesters Offered: On Demand

Restrictions: Permission of instructor and department required

EE 4805 - Electrical Engineering Project

A project in electrical engineering. An individual student or a group of students complete a mutually-agreed-upon project in consultation with a faculty member.

Credits: variable to 3.0; Repeatable to a Max of 6; Graded Pass/Fail Only

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor and department required

EE 4870 - Special Topics in Computer Engineering

Covers special topics in computer engineering.

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

Semesters Offered: On Demand

Restrictions: Permission of instructor and department required

EE 4901 - EE Design Project 1

The first semester of a program of study in which a group of students work on an engineering design project in consultation with a faculty member. (Senior project ready as defined by major substitutes for prerequisites)

Credits: 2.0

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

Semesters Offered: Fall

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

Pre-Requisite(s): (EE 3131 or (EE 3130 and EE 3305)) and (EE 3901 or EE 4900) and (EE 3170(C) or EE 3171(C) or EE 3173(C))

EE 4910 - EE Design Project 2

The second semester of a program of study in which a group of students work on an engineering design project in consultation with a faculty member. (Senior project ready as defined by major substitutes for prerequisites)

Credits: 2.0

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

Semesters Offered: Spring

Pre-Requisite(s): EE 4901

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, Summer

Restrictions: Must be enrolled in one of the following Major(s): Mechanical Engineering Tech, Surveying Engineering, Computer Network & System Admn

Pre-Requisite(s): MA 1031 or MA 1032 or MA 1160(C) or MA 1161(C) or MA 1135(C)

EET 2120 - Circuits II

Defines and applies sinusoidal steady-state AC concepts such as impedance, complex power, resonance, and frequency response. Applies basic network analysis tools to AC single phase and balanced three-phase networks, bridge circuits, and filters. AC circuit principles are reinforced by coordinated lab exercises.

Credits: 4.0

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

Semesters Offered: Fall

Pre-Requisite(s): EET 1120 and (MA 1160(C) or MA 1161(C) or MA 1135(C))

EET 2141 - Digital Electronics and Microprocessor Fundamentals

A study of the fundamental components used in digital logic circuits and microcomputer architecture and programming. Topics include: number systems and codes, Boolean algebra, combinational logic circuits, flip-flops, arithmetic circuits, counters and registers, decoders, multiplexers, memory organization, microcomputer addressing modes, stacks and subroutines.

Credits: 4.0

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

Semesters Offered: Fall

Pre-Requisite(s): EET 1120 or EET 1411

EET 2142 - Digital Design and Modeling Using VHDL

Emphasizes the language concepts of digital systems design using VHDL with emphasis on good design practices and writing verification testbenches. Students will gain valuable hands-on experience writing efficient hardware design code and performing simulations using ModelSim.

Credits: 3.0

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

Semesters Offered: Spring

Pre-Requisite(s): EET 2141

EET 2220 - Electronic Devices & Circuits

Introduction to solid-state electronic devices and their application. Studies diodes, transistors and operational amplifier ICs. Transistor biasing, temperature stabilization and gain calculations of single and multistage amplifiers. Studies power amplifiers, frequency response, heat sinking and power supply design.

Credits: 4.0

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

Semesters Offered: Spring

Pre-Requisite(s): EET 2120

EET 2233 - Electrical Machinery

Fundamental steady-state analysis of DC, AC polyphase and AC single-phase electrical machines as well as transformers.

Credits: 4.0

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

Semesters Offered: Fall, Summer

Pre-Requisite(s): EET 1411 or EET 2120(C)

EET 2241 - C++ and Matlab Programming

Introduction to C++ programming and MATLAB for use in solving problems encountered in engineering technology. C++ topics include the basics of syntax and program structure. Focuses on the basic capabilities of MATLAB and its programming environment.

Credits: 3.0

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

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Major(s): Electrical Eng Tech

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, Summer

Restrictions: Must be enrolled in one of the following Major(s): Electrical Eng Tech, 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 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

Restrictions: Must be enrolled in one of the following Major(s): Electrical Eng Tech

Pre-Requisite(s): EET 1411 or (EET 2120 and EET 2141) or EET 2411 or PH 2230 or EE 2110 or EE 3010 or EE 2112

EET 3390 - Power Systems

A study of the transmission of electrical power from generators to loads, system components and system performance. Covers basics of power systems and their analysis, the per-unit concept, faults on power circuit interrupting, system instrumentation, and automatic protection system.

Credits: 3.0

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

Semesters Offered: Fall

Pre-Requisite(s): EET 2233

EET 4141 - Microcontroller Interfacing

The design of systems, hardware, and software needed to perform serial and parallel data transmission between microcontrollers. Data collection using analog to digital converters, and analog and digital control outputs.

Credits: 4.0

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

Semesters Offered: Fall

Pre-Requisite(s): EET 2141 or CS 1121

EET 4142 - Digital Signal Processing Applications

Provides students with knowledge in architecture, instruction set, hardware and software development tools associated with a fixed point general purpose DSP. Includes applications of DSP in control of electric drives and power electronic devices.

Credits: 3.0

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

Semesters Offered: Spring

Pre-Requisite(s): EET 3367 and EET 4141

EET 4144 - Real-Time Robotics Systems

Covers the components of a robot system, safety, concepts of a work-cell system, geometry, path control, automation sensors, programming techniques, hardware, and software.

Credits: 4.0

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

Semesters Offered: On Demand

Pre-Requisite(s): EET 1411 or EET 2220 or PH 2230 or EE 2110 or EE 3010

EET 4147 - Industrial Robotic Vision Systems and Advanced Teach Pendant Programming

Procedures for setting up, teaching, testing, and modifying robot vision systems widely used in industrial automation. Introduces advanced Teach Pendant Programming to develop complex scenarios for integrating robots into industrial cells. Final project must demonstrate proficiency in setting up and programming an advanced robotic vision scenario.

Credits: 4.0

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

Semesters Offered: Fall, Summer

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

Pre-Requisite(s): EET 4144

EET 4253 - LabVIEW Programming for Data Acquisition

An introduction to graphical programming using LabVIEW. Data acquisition and control programs will be written. Transducer utilization and signal conditioning are studied, including handling of noise. DAQ interfaces will be designed, built, and implemented.

Credits: 3.0

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

Semesters Offered: Spring

Pre-Requisite(s): EET 1411 or EET 2220 or EE 2112 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: 3.0

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

Semesters Offered: Spring

Pre-Requisite(s): EET 3367 and MA 2160

EET 4373 - Advanced Programmable Controllers

Using Allen Bradley Micro Logix, SLC500, & PLC-5 programmable controllers, course covers structured programming, Sequential Function Charts, networking, proportional integral differential control, data acquisition and interfacing. The labs will require students to write and troubleshoot complex PLC programs.

Credits: 4.0

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

Semesters Offered: Spring

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

Pre-Requisite(s): EET 3373

EET 4380 - Alternative Energy Applications

An overview of world energy resources and energy consumption trends. Fundamental principles, applications, and viability of alternative energy sources such as wind, solar, and tidal will also be presented.

Credits: 3.0

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

Semesters Offered: On Demand

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

Pre-Requisite(s): EET 2233

EET 4460 - Senior Project I

Capstone course phase I, requiring the application of knowledge gained in lower division courses. Projects are normally team oriented, require weekly progress reports, and culminate with a final report and oral presentation.

Credits: 3.0

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

Semesters Offered: Fall, Spring, Summer

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

Pre-Requisite(s): EET 3281

EET 4480 - Senior Project II

A capstone course requiring the application of knowledge gained in lower division courses. Projects are normally team oriented, require weekly progress reports, and culminate with a final report and oral presentation.

Credits: 3.0; Repeatable to a Max of 6

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

Semesters Offered: Fall, Spring, Summer

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

EET 4999 - Professional Practice in Electrical Engineering Technology

Addresses engineering professional ethics, legal issues, professional development, and corporate culture as they relate to engineering technology graduates and our global society.

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

Engineering Fundamentals**ENG 1001 - Engineering Problem Solving**

Introduction to the engineering problem solving method and to modern tools used to solve problems.

Credits: 2.0

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

Semesters Offered: Fall

Pre-Requisite(s): (MA 1031(C) or MA 1032(C)) and (Spatial Visualization Score >= 19 or ENG 1002(C))

ENG 1002 - Introduction to 3-D Spatial Visualization

Intended for first-year engineering students with a demonstrated need for the development of 3-D spatial visualization skills. Topics include isometric sketching, orthographic projection, object transformations, 3-D coordinate systems, patterns folding to 3-D objects, and cross sections of solids.

Credits: 1.0

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

Semesters Offered: Fall, Spring

Restrictions: Permission of department required

ENG 1003 - Introduction to Computer Aided Drafting

Fundamentals of creating engineering drawings with modern CAD software. Topics include basic geometric construction, drawing modification, dimensioning, and working with layers. Designed for students with no CAD experience.

Credits: 1.0

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

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Class(es): Freshman, Sophomore

Pre-Requisite(s): ENG 1002 or ENG 1100 or ENG 1101

ENG 1100 - Engineering Analysis

An introduction to the engineering profession. Focuses on engineering analysis, computational skills, and communication skills.

Credits: 2.0

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

Semesters Offered: Spring

Pre-Requisite(s): ENG 1001 and (MA 1160(C) or MA 1161(C)) and (Spatial Visualization Score \geq 19 or ENG 1002(C))

ENG 1101 - Engineering Analysis and Problem Solving

An introduction to the engineering profession and to its various disciplines. Focuses on developing problem-solving skills, computational skills, and communication skills. Through active, collaborative work, students work on teams to apply the engineering problem-solving method to "real-world" problems.

Credits: 3.0

Lec-Rec-Lab: (0-0-5)

Semesters Offered: Fall, Spring, Summer

Pre-Requisite(s): (MA 1160(C) or MA 1161(C) or MA 2160(C) or MA 3160(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 or MA 2160(C) or MA 3160(C)) and (ENG 1101 or (ENG 1001 and ENG 1100)) and (Spatial Visualization Score \geq 19 or ENG 1002)

ENG 1505 - Introduction to Systems Engineering

Students utilize a software tool to establish the utility of systems modeling through relevant examples.

Credits: 1.0

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

Semesters Offered: Spring

Pre-Requisite(s): ENG 1001 or ENG 1101

ENG 1990 - Special Topics in Engineering

Engineering topics of interest to students and faculty that are not normally covered in the existing courses.

Credits: variable to 5.0; Repeatable to a Max of 6

Semesters Offered: On Demand

Restrictions: Permission of instructor required

ENG 2060 - Facilitating Group Learning

Development of facilitation skills in group environments. Topics include peer-learning strategies, developing inclusive classrooms, and facilitation techniques.

Credits: 1.0; Graded Pass/Fail Only

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

Semesters Offered: Fall, Spring

Restrictions: Permission of instructor required

Pre-Requisite(s): ENG 1102

ENG 2120 - Statics-Strength of Materials

The composition and resolution of forces and force systems, principles of equilibrium applied to various bodies, simple structures, friction, and 2nd moments of area. Intro to the mechanical behavior of materials, including calculation of stresses, strains, and deformations due to axial, torsional, and flexural loading. Uses MATLAB.

Credits: 4.0

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

Semesters Offered: Spring

Restrictions: May not be enrolled in one of the following Major(s): Mechanical Engineering, Civil Engineering

Pre-Requisite(s): MA 2160 and PH 2100 and ENG 1102

ENG 2505 - Low Fidelity Systems Modeling

Students utilize a software tool to model a range of natural and human-made systems to gain understanding and ability to apply a systems modeling approach for analysis of systems of increasing complexity.

Credits: 3.0

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

Semesters Offered: Spring

Pre-Requisite(s): ENG 1505(C) and MA 2160 and (ENG 1102 or CS 1121 or CS 1131)

ENG 2990 - Special Topics in Engineering

Engineering topics of interest to students and faculty that are not normally covered in the existing courses.

Credits: variable to 5.0; Repeatable to a Max of 6

Semesters Offered: On Demand

Restrictions: Permission of instructor required

ENG 3060 - Developing Mentoring Skills

Provides an overview of mentoring. Topics include various mentoring techniques, providing effective feedback, and observational strategies.

Credits: 1.0; Graded Pass/Fail Only

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

Semesters Offered: Fall, Spring

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

Pre-Requisite(s): ENG 2060

ENG 3200 - Thermodynamics/Fluid Mechanics

Provides engineering students with a unified understanding of the fundamental conservation laws and property accounting applied to thermodynamic and fluid dynamic systems. Topics will include but are not limited to: ideal gas behavior; heat, work, and energy; 1st and 2nd laws of thermodynamics; heat pumps; cycles; hydrostatics; Bernoulli; pipe flow and loss; and lift and drag. Uses MATLAB.

Credits: 4.0

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

Semesters Offered: Fall, Spring

Pre-Requisite(s): MA 2160 and CH 1112 or (CH 1150 and CH 1151) and PH 2100 and ENG 1102

ENG 3505 - Modeling Laboratory for Sustainable Systems

A laboratory course to accompany Sustainable Futures I. Puts into modeling practice the concepts, methodologies, and systems modeling to generate design alternatives.

Credits: 1.0

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

Semesters Offered: Fall

Pre-Requisite(s): ENG 1505 and ENG 2505 and ENG 4510(C)

ENG 3830 - Engineering Professional Practice

Students will integrate and solidify topics of professional communications, ethics, problem solving, and fundamental competencies of engineering. Students will enhance their understanding of consequences of engineering, design issues, legal aspects, ethical considerations, management, and leadership, through readings, research, and discussions.

Credits: 1.0

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

Semesters Offered: On Demand

Restrictions: Permission of department required

Pre-Requisite(s): ENG 1101 or (ENG 1001 and ENG 1100) and ENG 1102 and ENG 2120 or (MEEM 2110 and MEEM 2150) and ENG 3200 or (MEEM 2201 and MEEM 3201) and EE 3010 and (CEE 3101 or CS 1121 or GE 2300 or MSE 2100)

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

Restrictions: Permission of instructor required

ENG 4060 - Leadership in Group Environments

Develops collaborative leadership skills through active hands-on learning. Topics include collaborative software, communication, and group management strategies.

Credits: 1.0; Graded Pass/Fail Only

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

Semesters Offered: Fall, Spring

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

Pre-Requisite(s): ENG 3060

ENG 4070 - LEAP Leadership Practicum

Experience designed for the practical application of leadership knowledge, skills, and behaviors in the LEAP environment. The practicum experience will be designed and implemented by the student, with mentorship/guidance from the associated faculty.

Credits: variable to 6.0; Graded Pass/Fail Only

Semesters Offered: On Demand

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

Pre-Requisite(s): ENG 2060

ENG 4300 - Project Management

The various stages in a project life cycle will be covered and include initiation, planning, execution, and closeout. Basic tools such as the Project Charter, Network Diagrams Gantt, and budgeting will be covered. Basics of MS Project are included.

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): BUS 2100 or CEE 3710 or MA 2720 or MA 3710 or EE 3180 or BE 2100

ENG 4505 - Systems Analysis, Modeling, and Design

This course will focus on a cross disciplinary subset of systems drawn from engineering, business, and natural science. Students will concentrate on modeling methodology appropriate for moderate to large systems environments and a collaborative project where they apply what they have learned.

Credits: 3.0

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

Semesters Offered: Fall

Pre-Requisite(s): ENG 3505 and ENG 4510

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

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: variable to 4.0

Semesters Offered: On Demand

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

ENG 4905 - Senior Engineering Design Project

Students work in teams on one-semester open-ended capstone design projects developing and implementing original and creative solutions to real engineering problems. Students must be Senior Project ready as defined by major. May take ENG4905, ENG4900, or ENG4910.

Credits: variable to 4.0

Semesters Offered: On Demand

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

Pre-Requisite(s): ENG 3830(C) or ENG 4505

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: variable to 4.0

Semesters Offered: On Demand

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

Restrictions: Permission of instructor required

Enterprise**ENT 1960 - Enterprise Orientation-Spring**

An orientation for students to their specific enterprise. Covers enterprise specific topics but should also include organizational structure; past, present and future projects and their results.

Credits: 1.0

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

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required

ENT 2950 - Enterprise Project Work I

Interdisciplinary teams work as part of an enterprise to address real-world design projects or problems. Second-year students are responsible for achieving some prescribed objectives, as defined by their Enterprise team.

Credits: 1.0

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

Semesters Offered: Fall, Spring, Summer

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

ENT 2960 - Enterprise Project Work II

Interdisciplinary teams work as part of an enterprise to address real-world design projects or problems. Second- year students are responsible for achieving some prescribed objectives, as defined by their Enterprise team.

Credits: 1.0

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

Semesters Offered: Fall, Spring, Summer

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

ENT 2961 - Teaming in the Enterprise

Develops group problem-solving skills. Stresses interpersonal skills and skill assessment, communication, group process and teamwork, and action planning. Uses active, hands-on learning.

Credits: 2.0

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

Semesters Offered: Fall

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

ENT 2962 - Communication Contexts

An introduction to the demands of technical and professional communication in workplace settings, through analyzing project design team experiences.

Credits: 1.0

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

Semesters Offered: Spring

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

Pre-Requisite(s): UN 1025

ENT 3950 - Enterprise Project Work III

Interdisciplinary teams work as part of an enterprise to address real-world design projects or problems. Third-year students will practice designing approaches to solve problems and develop procedures to achieve specified project objectives.

Credits: 1.0

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

Semesters Offered: Fall, Spring, Summer

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

ENT 3953 - Ignite: Ideate, Innovate, Create!

Whether starting a business or working for an established company, creativity and innovation are keys to success. Course will explore creativity tools and techniques such as design thinking and human centered design to help generate ideas that provide value to society.

Credits: 1.0

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

Semesters Offered: Fall, Spring

ENT 3954 - Enterprise Market Principles

Examines the fundamental principles of marketing in the six stages of product life cycle (opportunity identification, product development, introduction, growth, maturity, and decline).

Credits: 1.0

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

Semesters Offered: Fall, Spring

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

ENT 3958 - Ethics in Engineering Design and Implementation

The focus of this course is on ethical considerations in the engineering design and implementation process. Basic ethical analysis tools will be explored through various exercises. Students will analyze and present 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): Sophomore, Junior, Senior

Pre-Requisite(s): ENG 1101 or (ENG 1001 and ENG 1100)

ENT 3959 - Fundamentals of Six Sigma I

This course introduces tools used for process improvement focusing on the DMAIC approach used widely in industry today.

Credits: 1.0

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

Semesters Offered: Fall

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

ENT 3960 - Enterprise Project Work IV

Interdisciplinary teams work as part of an enterprise to address real-world design projects or problems. Third-year students practice designing approaches to solve problems and develop procedures to achieve specified project objectives.

Credits: 1.0

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

Semesters Offered: Fall, Spring, Summer

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

ENT 3961 - Enterprise Strategic Leadership

This 1-credit module focuses on exploring research findings about leadership, the practice of leadership, and providing skill assessment and development opportunities. Topics include leadership traits, behaviors, theories, and leadership of change. Combines a variety of teaching methods, including self-assessment, cases, discussion, experiential exercises, role-playing, videotaping.

Credits: 1.0

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

Semesters Offered: Spring

Pre-Requisite(s): ENT 2961 and (EC 2001 or PSY 2000 or SS 2100 or SS 2200 or SS 2400 or SS 2500 or SS 2501 or SS 2502 or SS 2503 or SS 2504 or SS 2505 or SS 2600 or SS 2700)

ENT 3963 - Deliver: Explore, Develop, Execute!

if you have an idea that you believe addresses a need and could lead to commercialization, this course will help you to explore the path from idea to market through customer development, value assessment, business model planning, and execution.

Credits: 1.0

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

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Class(es): Sophomore, 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: Fall, Spring, Summer

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 - Design for Six Sigma

This course emphasizes the design for Six Sigma (DFSS) tools and methods used widely in industry to optimize new products and services.

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

ENT 3970 - Enterprise Special Topics

For the development of new, junior-level instructional modules in support of the enterprise.

Credits: 1.0; May be repeated

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

Semesters Offered: Fall, Spring, Summer

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

ENT 3971 - Seven Habits of Highly Effective People

Focuses on personal and professional effectiveness through greater productivity, increased influence in key relationships, stronger team unity and complete life balance. This course will explore these areas through interactive exercises, case studies, videos, and sharing of experiences.

Credits: 1.0

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

Semesters Offered: Spring

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

ENT 3979 - Alternative Energy Technologies and Processes

This course covers a wide range of alternative energy technologies with an emphasis on chemical and biochemical processing. Technologies covered may include biofuels, solar power, fuel cells, etc.

Credits: 1.0

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

Semesters Offered: Fall

Pre-Requisite(s): CH 1112 or (CH 1150 and CH 1151) and (MA 1160 or MA 1161)

ENT 3980 - Pre-Capstone Enterprise Project Work

Interdisciplinary teams work as part of an enterprise to address real-world design projects or problems. This course is to be taken by third-year or fourth-year enterprise students who have completed the junior-level project work, but are not approved as capstone-ready by their department.

Credits: 1.0; Repeatable to a Max of 2

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

Semesters Offered: Fall, Spring, Summer

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

Pre-Requisite(s): ENT 3950 and ENT 3960

ENT 3982 - Continuous Improvement Using Lean Principles

Fields from engineering through the social sciences are adopting continuous improvement using Lean principles to make their organizations successful. The evolution of these principles and the associated processes, methods, and tools are described and applied.

Credits: 1.0

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

Semesters Offered: Fall

ENT 3983 - The Culture of Continuous Improvement

A continuous improvement culture is based on humility and respect for people. Problem solving in this environment is highly participative, focuses on the issue not the person, and seeks to empower the employees closest to the work being performed.

Credits: 1.0

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

Semesters Offered: Spring

ENT 3984 - Lean Six Sigma Principles

Proven Lean Six Sigma problem-solving methods and statistical tools contribute to the success of any organization. Course covers Lean Six Sigma methodology, tools, and planning for a Green Belt certification project.

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

ENT 3985 - Lean Six Sigma Certification Project Execution

Execute a previously defined project using Lean Six Sigma problem-solving methods and statistical tools. Establish baselines; identify and validate root causes; identify, test, and implement a solution; and propose a method to sustain the gains.

Credits: 3.0

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

Semesters Offered: Spring

Restrictions: Permission of instructor required; Must be enrolled in one of the following Class(es): Junior, Senior

Pre-Requisite(s): ENT 3984

ENT 4900 - Senior Enterprise Project Work V Non-Capstone

Interdisciplinary teams work as part of an enterprise to address real-world projects or problems of significance to industry, government and communities. Fourth-year students gain experience in defining project objectives and planning strategies to achieve these objectives, and leading teams to accomplish project goals. This course is for students who are not participating in Enterprise to fulfill their capstone requirements.

Credits: 2.0

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

Semesters Offered: Fall, Spring, Summer

Restrictions: May not be enrolled in one of the following College(s): College of Engineering; Must be enrolled in one of the following Class(es): Senior

ENT 4910 - Senior Enterprise Project Work VI Non-Capstone

Interdisciplinary teams work as part of an enterprise to address real-world projects or problems of significance to industry, government and communities. Fourth-year students gain experience in defining project objectives and planning strategies to achieve these objectives, and leading teams to accomplish project goals. This course is for students who are not participating in Enterprise to fulfill their capstone requirements.

Credits: 2.0

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

Semesters Offered: Fall, Spring, Summer

Restrictions: May not be enrolled in one of the following College(s): College of Engineering; Must be enrolled in one of the following Class(es): Senior

ENT 4950 - Enterprise Project Work V Capstone

Interdisciplinary teams work as part of an enterprise to address real-world design projects or problems. Fourth-year students gain experience in defining project objectives, planning strategies to achieve these objectives, and leading technical teams to accomplish project goals. Must be Senior Project ready as defined by major.

Credits: 2.0

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

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of department required; Must be enrolled in one of the following Major(s): Civil Engineering, Chemical Engineering, Computer Engineering, Electrical Engineering, Environmental Engineering, Mechanical Engineering, Materials Science and Engrg, Software Engineering, Construction Management, Computer Network & System Admn, Electrical Eng Tech, Mechanical Engineering Tech, Surveying Engineering, Biomedical Engineering; Must be enrolled in one of the following Class(es): Senior

Pre-Requisite(s): (BE 3350 and BE 3700 and BE 3800 and BE 4900) or (CE 3620 or CEE 3620 or CE 3810 or CEE 3810) or (CM 4855(C) or (CS 3712 or CS 4711 or CS 4760) or (EE 3131 and EE 3901 and EE 3171(C) or EE 3173(C)) or (GE 3860 and GE 3880) or (ENT 3950 and ENT 3960 and MEEM 3000(C) and MEEM 3900 and MEEM 3502(C)) or (ENT 3950 and ENT 3960 and MA 3710 and MEEM 3750(C) and MEEM 3201(C) and MEEM 3911) or (MY 3110 or MSE 3110 and MY 3200 or MSE 3120 and MY 3210 or MSE 3130 and MY 3300 or MSE 3140 and MY 4940 or MSE 3190 and MSE 4131(C)) or (HU 3120 and EET 3281 and EET 4253(C)) or (MET 4460(C) or SAT 3812(C) or SU 4100(C) or ENG 3830

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 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 (EC 2001 or PSY 2000 or SS 2100 or SS 2200 or SS 2400 or SS 2500 or SS 2501 or SS 2502 or SS 2503 or SS 2504 or SS 2505 or SS 2600 or SS 2700)

ENT 4960 - Enterprise Project Work VI Capstone

Interdisciplinary teams work as part of an enterprise to address real-world 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 and (BE 4900 or (CEE 3620 or CEE 3810) or CM 4855 or (CS 3712 or CS 4711 or CS 4760) or (EE 3171 or EE 3173) or (GE 3860 or GE 3880) or (MEEM 3000(C) and MEEM 3502(C)) or (MEEM 3750 and MEEM 3201) or (MSE 4131 and MSE 4141(C)) or CMG 4210 or EET 4253 or MET 4460 or SAT 4541 or SU 4100 or (ENG 3830 or ENG 4505))

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 enterprise.

Credits: 1.0; May be repeated

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

Semesters Offered: Fall, Spring

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

English as a Second Language**ESL 0210 - High Beginner Reading**

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, and critical thinking.

Credits: 3.0; May be repeated; Graded Pass/Fail Only

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

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0211 - High Beginner Vocabulary

For students of English as a second language; not for native speakers of English. Emphasis is on vocabulary acquisition, word form, and morpheme recognition.

Credits: 1.0; Graded Pass/Fail Only

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

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0220 - High Beginning Writing

For students of English as a second language; not for native speakers of English. Students work collaboratively on writing tasks of various genres through multiple drafts emphasizing structural organization of sentences and paragraphs, and syntactical accuracy.

Credits: 3.0; May be repeated; Graded Pass/Fail Only

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

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0230 - High Beginner Listening and Speaking

For students of English as a second language; not for native speakers of English. Emphasis on developing oral fluency, conversation, listening strategies, and presentation skills on familiar topics.

Credits: 3.0; May be repeated; Graded Pass/Fail Only

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

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0231 - High Beginner Pronunciation

For students of English as a second language, not native speakers of English. Emphasis on prosodic elements of second language speech. Focus on listening for features of speech. Time is divided between classroom instruction and lab.

Credits: 1.0; Graded Pass/Fail Only

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

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0240 - High Beginner Grammar

For students of English as a second language; not for native speakers of English. Students receive explicit instruction and form-focused activities to develop mechanics and syntactical accuracy emphasizing various simple, complex, and compound structures, verb forms, and other grammatical elements.

Credits: 1.0; May be repeated; Graded Pass/Fail Only

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

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

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; May be repeated; Graded Pass/Fail Only

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0310 - Intermediate Reading I

For students of English as a second language, not for native speakers of English. Emphasis is on comprehension of main ideas and structural details, critical-thinking skills and class discussion. Students learn to take notes, outline and summarize.

Credits: 3.0; May be repeated; Graded Pass/Fail Only

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

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0311 - Intermediate Vocabulary I

For students of English as a second language; not for native English speakers. The emphasis is on vocabulary acquisition for academic study. Students will learn techniques for understanding vocabulary words from context; analyze lexical roots, prefixes and suffixes; and become familiar with word association mapping and idiomatic expressions.

Credits: 1.0; Graded Pass/Fail Only

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

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0320 - Intermediate Writing I

For students of English as a second language, not for native speakers of English. Students work collaboratively on writing tasks of various genres through multiple drafts; emphasizes structural organization, thesis development and syntactical accuracy.

Credits: 3.0; May be repeated; Graded Pass/Fail Only

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

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0330 - Intermediate Listening and Speaking I

For students of English as a second language; not for native speakers of English. Emphasis is on developing oral fluency, skills needed for group work, academic listening strategies and academic presentation skills on familiar, informative topics.

Credits: 3.0; May be repeated; Graded Pass/Fail Only

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

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0331 - Intermediate Pronunciation I

For students of English as a second language, not native speakers of English. Emphasis on prosodic elements of second language speech. Focus on identifying features of speech. Time is divided between classroom instruction and lab.

Credits: 1.0; Graded Pass/Fail Only

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

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0340 - Intermediate Communicative Grammar

For students of English as a second language; not for native speakers of English. Using explicit instruction and form-focused activities to develop students' syntactical accuracy; emphasizes various simple, complex and compound structures, verb forms and other grammatical elements.

Credits: 1.0; May be repeated; Graded Pass/Fail Only

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

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0350 - Intermediate Reading II

For speakers of English as a second language; not for native speakers of English. This is an intermediate reading course for academically oriented ESL students. This course is designed to further develop effective reading strategies for adapted academic texts of varying lengths.

Credits: 3.0; Graded Pass/Fail Only

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

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0351 - Intermediate Vocabulary II

For students of English as a second language; not for native English speakers. Further emphasis on vocabulary acquisition but with more range and depth than in Intermediate Vocabulary I. Demonstrate understanding of figurative language, word relationships, and nuances in word meanings. Students will improve their ability to understand and correctly use academic vocabulary that is technical and precise, and meant to convey specific ideas, often with reduced context.

Credits: 1.0; Graded Pass/Fail Only

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

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0360 - Intermediate Writing II

For students of English as a second language, not for native speakers of English. Students work collaboratively on writing tasks of various genres through multiple drafts; further development on structural organization, thesis development and syntactical accuracy.

Credits: 3.0; Graded Pass/Fail Only

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

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0370 - Intermediate Listening and Speaking II

For students of English as a second language; not for native speakers of English. Further development of oral fluency, skills needed for group work, academic listening strategies, and academic presentation skills on familiar, informative topics.

Credits: 3.0; Graded Pass/Fail Only

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

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0371 - Intermediate Pronunciation II

For students of English as a second language, not native speakers of English. Emphasis on prosodic elements of second language speech. Focus on identifying and anticipating features of speech. Time is divided between classroom instruction and lab.

Credits: 1.0; Graded Pass/Fail Only

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

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0380 - Intermediate Communicative Grammar II

For students of English as a second language, not for native speakers of English. Using explicit instruction and form-focused activities to develop students' syntactical accuracy; further developments on various simple, complex and compound structures, verb forms and other grammatical elements.

Credits: 1.0; Graded Pass/Fail Only

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

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0390 - Intermediate Special Topics

For students of English as a second language, not for native speakers of English. Concentrated study of a specific area of ESL in greater depth than in other courses. Examples: English for computer users, idioms. Contact Director of ESL Programs.

Credits: variable to 6.0; May be repeated; Graded Pass/Fail Only

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0399 - Intermediate Independent Study

For students of English as a second language, not for native speakers of English. Selected areas in ESL based on interest and need of student. Interested students should contact the Director of English as a Second Language Programs.

Credits: variable to 6.0; May be repeated; Graded Pass/Fail Only

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0410 - Advanced Reading I

For students of English as a second language, not for native speakers of English. Emphasis is on preparing students for academic study through the development of effective reading strategies, note-taking, inferring, summarizing, critical thinking and discussion.

Credits: 3.0; May be repeated; Graded Pass/Fail Only

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

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0411 - Advanced Vocabulary I

For students of English as a second language, not for native speakers of English. Emphasis is on helping students increase their command of idiomatic English and academic vocabulary in daily and academic situations with attention given to correct pronunciation. Additional practice with the Academic Word List (AWL) will include short writing assignments.

Credits: 1.0; Graded Pass/Fail Only

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

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0412 - Advanced English for Business

This course is designed for students of English as a second language, not for native speakers of English. Emphasis is on acquiring vocabulary necessary for academic study of courses required in business majors.

Credits: 1.0; May be repeated; Graded Pass/Fail Only

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

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0413 - Advanced English for Engineering

This course is designed for students of English as a second language, not for native speakers of English. Emphasis is on acquiring vocabulary necessary for academic study of courses required in engineering majors.

Credits: 1.0; May be repeated; Graded Pass/Fail Only

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

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0414 - Advanced English for Math

This course is designed for students of English as a second language, not for native speakers of English. Emphasis is on acquiring vocabulary necessary for academic study of mathematics courses.

Credits: 1.0; May be repeated; Graded Pass/Fail Only

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

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0415 - Advanced English for Science

This course is designed for students of English as a second language, not for native speakers of English. Emphasis is on acquiring vocabulary necessary for academic study of courses required in biological science majors.

Credits: 1.0; May be repeated; Graded Pass/Fail Only

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

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0420 - Advanced Writing I

For students of English as a second language, not for native speakers of English. Students work collaboratively on writing tasks of various genres through multiple drafts; emphasizes coherence and unity, source use and documentation and language formality.

Credits: 3.0; May be repeated; Graded Pass/Fail Only

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

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0430 - Advanced Listening and Speaking I

For students of English as a second language; not for native speakers of English. Emphasis is on developing oral fluency academic listening strategies, argument development, skills needed for group work and academic presentation skills with a focus on persuasive speaking.

Credits: 3.0; May be repeated; Graded Pass/Fail Only

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

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0431 - Advanced Pronunciation I

For students of English as a second language, not native speakers of English. Emphasis on prosodic elements of second language speech. Focus on anticipating features of speech. Time is divided between classroom instruction and lab.

Credits: 1.0; Graded Pass/Fail Only

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

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0440 - Advanced Communicative Grammar I

For students of English as a second language; not for native speakers of English. Using explicit instruction, and form-focused activities to develop students' error analysis skills; emphasizes correcting sentence constructions and connections, verb consistency and other common errors.

Credits: 1.0; May be repeated; Graded Pass/Fail Only

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

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0450 - Advanced Reading II

For students of English as a second language, not for native speakers of English. Emphasis is on preparing students for academic study through the development of effective reading strategies, note-taking, inferring, summarizing, critical thinking and discussion in academic settings using slightly adapted academic texts.

Credits: 3.0; Graded Pass/Fail Only

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

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0451 - Advanced Vocabulary II

For students of English as a second language, not for native speakers of English. Emphasis is on mastering the words and phrases that are specific to academic writing, speaking and research, as well as everyday idioms, expressions, and abbreviations. Predicting the pronunciation pattern of new words and phrases; lexical bundles and collocation usage will be also covered.

Credits: 1.0; Graded Pass/Fail Only

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

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0460 - Advanced Writing II

For students of English as a second language, not for native speakers of English. Students work collaboratively on writing tasks of various genres through multiple drafts; further development on coherence and unity, source use and documentation and language formality.

Credits: 3.0; Graded Pass/Fail Only

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

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0470 - Advanced Listening and Speaking II

For students of English as a second language, not for native speakers of English. Further development of oral fluency, academic listening strategies, argument development, skills needed for group work, and academic presentation skills with a focus on persuasive speaking.

Credits: 3.0; Graded Pass/Fail Only

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

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0471 - Advanced Pronunciation II

For students of English as a second language, not native speakers of English. Emphasis on prosodic elements of second language speech. Focus on producing features of speech. Time is divided between classroom instruction and lab.

Credits: 1.0; Graded Pass/Fail Only

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

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0480 - Advanced Communicative Grammar II

For students of English as a second language, not native speakers of English. Using explicit instruction and form-focused activities to develop students' error analysis skills; further development on correcting sentence constructions and connections, verb consistency and other common errors.

Credits: 1.0; Graded Pass/Fail Only

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

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0490 - Advanced Special Topics

For students of English as a second language, not for native speakers of English. Concentrated study in a specific area of ESL in greater depth than in other courses. Examples: academic writing, business English. Contact Director of ESL Programs.

Credits: variable to 6.0; May be repeated; Graded Pass/Fail Only

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0491 - Transitional Writing

For students of English as a second language, not for native speakers of English. Students work collaboratively on writing tasks of various genres through multiple drafts; emphasizes argument construction/deconstruction, source integration, sentence variety and cohesion.

Credits: 3.0; May be repeated; Graded Pass/Fail Only

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

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0492 - Transitional Listening and Speaking

For students of English a second language, not for native speakers of English. Emphasis is on developing oral fluency, academic listening strategies, research skills, skills needed for group work and academic presentation skills with a focus on academic research projects.

Credits: 3.0; May be repeated; Graded Pass/Fail Only

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

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0493 - Transitional Reading and Vocabulary

For students in English as a second language, not for native speakers of English.

This course emphasizes the continued acquisition of higher level reading skills needed for university courses, expansion of receptive and productive academic vocabulary, comprehension of authentic American university texts as well as other authentic reading materials of varying lengths.

Credits: 3.0; Graded Pass/Fail Only

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

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 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

Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0499 - Advanced Independent Study

For students of English as a second language, not for native speakers of English.

Selected areas of ESL based on student need. Interested students should contact the Director of English as a Second Language Programs.

Credits: variable to 6.0; May be repeated; Graded Pass/Fail Only

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

ESL 0520 - Academic Support Listening/Speaking

For students of English as a second language; not for native speakers of English.

Emphasis on improving pronunciation and conversation skills; academic discussion skills; academic presentations.

Credits: 3.0; May be repeated; Graded Pass/Fail Only

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

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

ESL 0560 - Research Writing I

For international graduate students of English as a second language, not for native speakers of English. Students work on improving academic reading and writing skills; emphasizes rhetorical analysis, cohesion and coherence, source use, research skills and syntactical accuracy.

Credits: 3.0; Graded Pass/Fail Only

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

Semesters Offered: Fall

ESL 0580 - Research Writing II

For international graduate students of English as a second language, not for native speakers of English. Students work on improving academic reading and writing skills; emphasizes graduate research writing and academic presentations.

Credits: 3.0; Graded Pass/Fail Only

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

Semesters Offered: Spring

ESL 0590 - Academic Support Spec Topics

For students of English as a second language, not for native speakers of English.

Study a specific area of ESL in greater depth than in other courses. Examples: graduate/research writing, business English, academic presentations. Contact Director of ESL Programs.

Credits: variable to 4.0; May be repeated; Graded Pass/Fail Only

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

ESL 0599 - Academic Support Indep Study

For students of English as a second language, not for native speakers of English.

Selected areas in ESL based on student need and interest. Interested students should contact the Director of English as a Second Language Programs.

Credits: variable to 6.0; May be repeated; Graded Pass/Fail Only

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Major(s): English as a Second Language

Visual and Performing Arts

FA 1601 - Introduction to Audio Production

An introduction to hands-on creative and technical work in sound. Work covers script analysis, story telling approaches, dialog direction and editing, sound effect and ambiance design, music integration and DAW based mixing.

Credits: 3.0

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

Semesters Offered: Fall

FA 1602 - Introduction to Music Mixing

A hands-on introduction to mixing music with emphasis on the support of musical principles and style. Students develop a technical understanding and practice the manipulation of volume, frequency, dynamics, pitch, and time to support the focus, rhythm, melody, and mood of a wide variety of musical styles.

Credits: 3.0

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

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 and pattern fitting/alteration.

Credits: 3.0

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

Semesters Offered: Fall - Offered alternate years beginning with the 2017-2018 academic year

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: (0-0-4)

Semesters Offered: Fall, Summer

FA 2123 - World Music

This course introduces the student to the diversity of traditional music from around the globe. Students will explore the universal importance of music, its place within a global community, and effects of technology on the cross pollination of musical styles.

Credits: 3.0

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

Semesters Offered: Fall, Summer - Offered alternate years beginning with the 2017-2018 academic year

FA 2150 - Creative Drawing Processes

Students redefine "drawing" and challenge preconceptions of what it means to be "creative" through a range of exercises using materials such as paint, pencils, photos, video, and collage. Practice close observation to see the world in new ways.

Credits: 3.0

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

Semesters Offered: Spring, Summer

FA 2160 - Creative Practices

Students will mindfully cultivate their creativity while making art connected to specific interests. Hands-on practice with basic photo, drawing, painting, and/or collage compliments theories of how artists/designers find inspiration. Prior drawing experience recommended.

Credits: 3.0

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

Semesters Offered: Spring - Offered alternate years beginning with the 2016-2017 academic year

FA 2190 - Art and Nature

Explore "nature" through art using materials ranging from what you find outdoors to digital media. Visits to natural sites provide inspiration and practice with creative fundamentals. Explore expressivity, brainstorming, project development, and collaboration.

Credits: 3.0

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

Semesters Offered: Fall

FA 2222 - Film Music

This course surveys the development of film music. Students will learn how music functions to support the aesthetic/narrative elements of the story. Students will learn skills to identify how music manipulates the listener and how composers shape that manipulation.

Credits: 3.0

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

Semesters Offered: Fall, Summer

FA 2300 - Art and Design Studio

Introduction to art and design as visual art. Explores design principles and creative problem solving using multiple materials. Students also examine design's ability to shape and interpret information. Hands-on studio work, lectures and discussions. Emphasizes creativity, inventiveness, and experimentation.

Credits: 3.0

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

Semesters Offered: Fall, Summer

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

FA 2305 - Ceramics I

Introduces handbuilding ceramic techniques, including coil, slab, pinch and wheel throwing. The goal is to allow students to be individually creative through experimenting with the possibilities in three-dimensional form. Historical, contemporary, functional and sculpture processes will be explored.

Credits: 3.0

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

Semesters Offered: Fall, Summer

FA 2315 - Beginning Wheel Throwing

Learning to use the potters wheel as an expressive tool is the goal of this course. In the context of traditional techniques for creating vessel forms students will also be challenged to explore their individual expressive and creative abilities.

Credits: 3.0

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

Semesters Offered: Fall, Summer

FA 2320 - Color and Meaning

An introductory level course in which students discover their personal palettes and explore color schemes. Use paint, basic photography, and collage to tap the expressive potential of color. Solve practical color problems and create poetic color compositions.

Credits: 3.0

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

Semesters Offered: Fall

FA 2330 - Art Appreciation

Introduces students to analytical tools to critically observe the visual world. By studying arts media, artists and designers, creative and technical processes, principles of design, as well as major works of art, students will express their own ideas about the visual experience in written form.

Credits: 3.0

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

Semesters Offered: Fall, Spring, Summer

FA 2361 - Scenic Art & Scenic Illustration

Students will learn small-format drawing, painting, and illustration techniques for theatre and architectural design, as well as large-scale scenic painting techniques for painting of murals, faux finishes, theatre, and opera. Lectures, discussions, and hands-on studio practice.

Credits: 3.0

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

Semesters Offered: Spring - Offered alternate years beginning with the 2016-2017 academic year

Pre-Requisite(s): FA 1701(C)

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

Reinforcement of music fundamentals, including musical notation; major, minor scales; intervals; triads; rhythm; and an introduction to musical analysis. Provides rudimentary ear training. Introduces music writing, both manual and with notation software.

Credits: 3.0

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

Semesters Offered: Fall

FA 2501 - Basic Musicianship: Skill Acquisition in Music Reading, Sight-Singing, and Ear-Training

Skill acquisition in music reading, sight-singing, keyboard harmony and ear-training. Provides an introduction to melodic and rhythmic solfege systems. Class should be taken before or concurrently with FA2500.

Credits: 3.0

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

Semesters Offered: Fall

FA 2520 - Music Appreciation

Survey of the nature of Western music with an emphasis on the developments in the aesthetics, theories, and media of music, including electronic music, multimedia works, and non-Western influences.

Credits: 3.0

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

Semesters Offered: Fall, Spring, Summer

FA 2570 - Music Lessons for Brass, Woodwind, String, Percussion, Harp, Piano, Voice, Guitar

Professional private music instruction on brass, woodwind, string, piano, guitar, voice, organ, and harp. Concert grand harp available on campus. Guitar rentals available from instructor. One semester may be counted toward General Education co-curricular requirements.

Credits: 0.5; May be repeated; Graded Pass/Fail Only

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

Semesters Offered: Fall, Spring, Summer

FA 2580 - Group Voice

The fundamentals of speech and singing including information about the vocal instrument, the vocal process, vocal technique, and how to learn and perform simple solo songs.

Credits: 3.0

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

Semesters Offered: On Demand

FA 2600 - Beginning Acting

Teaches basic techniques of acting to include script and character analysis, internal and external approaches to performance, and basic use of voice and body.

Credits: 3.0

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

Semesters Offered: Fall, Spring

FA 2640 - Stage Makeup

A practical guide to the theory and practice of makeup for the stage. Students will study basic techniques including corrective, aging, character makeup, and special effects.

Credits: 3.0

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

Semesters Offered: Spring - Offered alternate years beginning with the 2018-2019 academic year

FA 2650 - Audition Techniques

Students learn to prepare for the many types of auditions encountered in the professional world of performance through simulated audition situations, from the theatrical cattle-call to the screen test in film. Additionally, professional interviewing techniques are taught and practiced through simulation.

Credits: 3.0

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

Semesters Offered: Spring - Offered alternate years beginning with the 2016-2017 academic year

Pre-Requisite(s): FA 2600

FA 2660 - Acting Practicum

Performance in a stage production or electronic media project. The project must be approved by the instructor either through audition or written contract of planned project.

Credits: 1.0; May be repeated

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

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required

FA 2661 - Backstage Practicum

Open to students selected for the crew of a mainstage theatre production sponsored by the Department of Visual and Performing Arts. Positions on stage crews are open to all MTU students. Work assignments will be made by the technical director of the Department of Visual and Performing Arts.

Credits: variable to 3.0; May be repeated

Semesters Offered: Fall, Spring

FA 2662 - Sound Practicum

Students get hands-on experience in live and recorded sound as well as in system maintenance and design. This work is done in a simulated internship experience. Students are expected to take this course multiple times and work towards leadership positions.

Credits: variable to 3.0; May be repeated

Semesters Offered: Fall, Spring

Pre-Requisite(s): FA 1702 and (FA 1662 or FA 1664)

FA 2663 - Career Development

Provides students the opportunity to attend professional events which contribute to the development of their careers. Students will experience seminars, workshops, performance opportunities, competitions, and may perform services and interact with professionals at such events as 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: Must be enrolled in one of the following Major(s): Sound Design, Theatre & Entertain Tech (BS), Theatre & Electr. Media Perf., Audio Production & Technology

FA 2701 - Drafting for the Entertainment Industry

Basics of hand drafting conventions and standards used in the entertainment industry. Focus on design and technical techniques for views such as: ground plans, elevations, sections, detail drawings, orthographic projections, scale perspective drawings. Introduces industry-specific CAD programs.

Credits: 3.0

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

Semesters Offered: Spring, Summer

FA 2705 - Stage Properties - Designing and Crafting

A focus on the design, research, production, and management of stage properties including: script, analysis, period and style, appropriateness, set dressing. Development and utilization of effective tools, materials, and techniques for structure, details, and finishing.

Credits: 3.0

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

Semesters Offered: Spring - Offered alternate years beginning with the 2018-2019 academic year

Pre-Requisite(s): FA 1701(C)

FA 2710 - Movement for Performers

Develops physical flexibility and strength, beginning with discovery of the body's physical center. The student will learn to create characters by focusing on posture, movement in space, and kinesics.

Credits: 3.0

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

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

FA 2720 - Sound in Art and Science

Engagement with critical, historical, and creative approaches to sound in Entertainment, Art, Technology, and Science. Integrated with a historical overview of aural environment and its application to designed environments from zen gardens to Harley exhaust.

Credits: 3.0

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

Semesters Offered: Summer

FA 2730 - Costume Crafts

Research and exploration of the theatrical techniques used to create costume crafts and personal props. Practical projects will challenge students to develop skills in millinery, leatherwork, painting and dyeing, fabric manipulation, mask making, jewelry, and safe use of materials.

Credits: 3.0

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

Semesters Offered: Fall - Offered alternate years beginning with the 2018-2019 academic year

FA 2820 - Theatre Appreciation

Students engage theatre as a phenomenon precipitating experiences affirming life and sparking insight. Exploration of creativity comes through exercises and play writing; critical thinking is practiced in script analysis. Aesthetics, and production roles are applied in staging a short play.

Credits: 3.0

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

Semesters Offered: Fall, Spring

FA 2830 - Voice and Articulation

An applied study of the use of voice. Students work to develop stronger, more vibrant and articulate professional speech. Accent reduction is covered extensively. Additionally, techniques for media are introduced.

Credits: 3.0

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

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

FA 3000 - Visual & Performing Arts Tour

Students participating in fine arts performance tours taking place outside of regular academic terms are eligible to receive credit based on the time span of the tour and the nature of the itinerary. Requires active membership in the touring group or permission of director.

Credits: variable to 3.0; May be repeated; Graded Pass/Fail Only

Semesters Offered: On Demand

Restrictions: Permission of instructor required

FA 3112 - Music Composition I

This course is a study in the art of acoustic instrumental, vocal and MIDI composition. Students will study music of contemporary composers and create compositions for performance.

Credits: 3.0

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

Semesters Offered: Fall

Pre-Requisite(s): FA 2500 and FA 3530

FA 3122 - Music Composition II

This course is a continuation of Music Composition I. Students expand their skills to include composition for media including, film, television, and digital arts. Students will apply their skills to create fully realized live performances of their compositions.

Credits: 3.0

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

Semesters Offered: Spring

Pre-Requisite(s): FA 2500 and FA 3530 and FA 3112

FA 3133 - Contemporary Music: The Search for New Sounds

Contemporary Music will explore music from the late nineteenth century through today. The focus of the class will be modern composers' search for new sounds using electronic instruments, popular music, non-western music, and new performance techniques.

Credits: 3.0

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

Semesters Offered: Spring - Offered alternate years beginning with the 2013-2014 academic year

Pre-Requisite(s): FA 2500 and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

FA 3150 - Drawing II

Observational and imaginative drawing including the human figure. Non-representational drawing. Contemporary drawing systems, concepts, and processes. Emphasizes proportion, structural framework, visual measurement, movement, and relationships. Students work in a variety of drawing media.

Credits: 3.0

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

Semesters Offered: Spring

Pre-Requisite(s): FA 2050 or FA 2150 or FA 2300 or FA 2305 or FA 2330 or FA 2160

FA 3305 - Creative Ceramics

Addresses ceramic theory, history, and science, and aims to develop the content and quality of students' work in clay. Students will learn new ways of creating forms through use of the wheel, molds, and study of clay and glaze technologies.

Credits: 3.0

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

Semesters Offered: Spring, Summer

FA 3330 - Art History - Prehistory to Renaissance

Surveys world art and architecture from the Paleolithic (30,000BC) to the Renaissance (1500AD). Focusing on city building, cave painting, glass, ceramics, frescoes, and metal casting, students will interpret the visual arts as historical evidence and expressions of cultural beliefs.

Credits: 3.0

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

Semesters Offered: Fall, Summer

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

FA 3333 - Contemporary Sculpture Studio

Introduction to contemporary sculpture using a range of materials and approaches. Emphasizes development of student's creative language. Hands-on studio work, lectures, discussions. Class takes place in Rozsa gallery; includes student exhibit at end of semester.

Credits: 3.0

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

Semesters Offered: Fall

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

FA 3335 - Traditional Sculpture Studio

Introduction to traditional ways of making sculpture around the world. Students develop studio skills while studying creative traditions from varied cultures. Hands-on studio work, lectures, discussions. Class takes place in Rozsa gallery; includes student exhibit at end of semester.

Credits: 3.0

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

Semesters Offered: Spring

Pre-Requisite(s): UN 1015 and (UN 1025)

FA 3340 - Art History - Renaissance to Today

Surveys Western art from the Renaissance (1500AD) to today. Focusing on painting, sculpture, architecture, and photography. We will study art in relation to its national, international, social, cultural, and historical contexts.

Credits: 3.0

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

Semesters Offered: Spring, Summer

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

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: (0-0-4)

Semesters Offered: On Demand

Pre-Requisite(s): FA 2305 or FA 3305

FA 3400 - Keweenaw Symphony Orchestra

The KSO is a college-community orchestra comprising Tech students, Tech faculty, and community musicians. The ensemble performs the great orchestra, opera, and ballet masterworks. The orchestra presents four-five yearly concerts, including regular concert tours. Auditions 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 - Conducting and Interpretation

Fluency in reading, analyzing, and interpreting orchestral, band, and choral music scores; principles and techniques of conducting a music ensemble; live conducting experiences with music ensembles; in-depth analysis of live and recorded classical, jazz, and rock music; fundamentals of musicianship.

Credits: 3.0

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

Semesters Offered: Spring

Pre-Requisite(s): FA 2500

FA 3510 - Concert Choir

A select ensemble made up of student and community singers studying and performing traditional choral literature ranging from chant to avant-garde compositions. Activities include campus and community performances and occasional international tours. Audition required.

Credits: 1.0; May be repeated

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

Semesters Offered: Fall, Spring

FA 3530 - Music Theory II

Study of fundamentals of tonal harmony, including harmonic progression and principles of voice-leading. Introduction to formal and harmonic analysis. Students will complete beginning projects in music composition.

Credits: 3.0

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

Semesters Offered: Spring

Pre-Requisite(s): FA 2500

FA 3550 - History of Jazz

Covers the musical, historical, and sociological elements of America's only original musical art form, jazz. Focuses on the major stylistic eras from 1900 to the present in addition to the major artists and their contributions. Emphasizes developing interactive, aural, and critical skills.

Credits: 3.0

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

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

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

FA 3560 - Music History

Developments in western classical music from the 1770s to 1970s in Europe and America. Includes a brief examination of Baroque music. Concentrates on music, style, aesthetics, culture, and biographies of major composers from the Classical, Romantic, and Twentieth-Century periods.

Credits: 3.0

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

Semesters Offered: Spring, Summer

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

FA 3565 - Masterworks in Western Music Literature

Examination of selected works from the canon of Western Music in context of relevant historical events. Students will explore the relation of text and music, ritual and music, rhetorical tropes in music as well as expressions of musical form.

Credits: 3.0; Repeatable to a Max of 6

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

Semesters Offered: Fall - Offered alternate years beginning with the 2013-2014 academic year

Pre-Requisite(s): FA 2500(C) or FA 2501(C)

FA 3580 - Chamber Choir

Participation in the Chamber Choir provides opportunities for students to explore and perform music written for small choir. Repertoire from varied styles and time periods (from antiquity to the present) will be prepared and presented in formal and informal performance settings. Audition required.

Credits: 1.0; May be repeated

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

Semesters Offered: Fall, Spring

FA 3600 - Advanced Acting

Students explore acting through analytical and theoretical study of script and characters. Understanding of characters in the context of a play or film will prepare students to apply advanced acting techniques such as Meisner and Stanislavski.

Credits: 3.0

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

Semesters Offered: Spring - Offered alternate years beginning with the 2018-2019 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): FA 2600 and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

FA 3620 - Acting for Television and Film

Advanced applications of fundamental acting technique and presentation skills with the added dynamic of the camera. Students will explore scene work for television and film, as well as commercial performance techniques for advertising in digital media.

Credits: 3.0

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

Semesters Offered: Spring - Offered alternate years beginning with the 2013-2014 academic year

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: Summer

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

FA 3630 - The Beatles and the Beach Boys: An Analysis of Their Music, Their Evolution, Their Rivalry

Analysis of biography, formative vs. mature style, musical structure, and historical impact of both bands. Offered online, second half of summer term.

Credits: 3.0

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

Semesters Offered: 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

FA 3660 - Advanced Acting Practicum for Film/Video/Stage

Practical experience of the production processes of theatre and media. Students will research, rehearse, and perform a role in an approved theatre or media project.

Credits: 1.0; Repeatable to a Max of 2

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

Semesters Offered: Fall, Spring

Restrictions: Permission of instructor required

Pre-Requisite(s): FA 2660

FA 3661 - Design & Management Practicum

Open to students who take significant responsibility for a Visual and Performing Arts production, such as stage manager, assistant designer, or assistant director.

Credits: variable to 3.0; May be repeated

Semesters Offered: Fall, Spring

Pre-Requisite(s): FA 2661

FA 3662 - Advanced Sound Practicum

Open to students who take significant responsibility for sound on a major production, such as sound designer, recording engineer, live sound engineer.

Credits: variable to 3.0; May be repeated

Semesters Offered: Fall, Spring, Summer

Pre-Requisite(s): FA 1662 and FA 1664 and FA 1702 and FA 2662 and FA 3730

FA 3663 - Professional Presentation

Provides students the opportunity to present at professional events which contribute to the development of their careers. Students will prepare and present design, technical, or performance projects, papers, and/or posters to be viewed and critiqued by professionals at such events as KCACTF, AES, USITT, and URTA.

Credits: 1.0; Repeatable to a Max of 4

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

Semesters Offered: Fall, Spring

Pre-Requisite(s): FA 3700(C) or FA 3730(C) or FA 3750(C) or FA 3760(C)

FA 3666 - Professional Audition

The objective of this course is to provide experience for performers to engage in auditioning for professional media and theatre companies. Students will research the expectations for unique acting opportunities and develop a plan for auditioning. Students will present their work at a professional audition.

Credits: 1.0; Repeatable to a Max of 2

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

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Major(s): Theatre & Electr. Media Perf.; May not be enrolled in one of the following Class(es): Freshman

FA 3680 - Period Acting Styles

Provides knowledge and experience in playing the manners, movement, and language in plays of the most frequently performed periods.

Credits: 3.0

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

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

Pre-Requisite(s): FA 2600 or FA 2820

FA 3700 - Scenic Design

Fundamentals of designing theatrical scenery through various explorations and projects. Focus on professional design development and presentation techniques: theatrical drafting conventions, renderings, scale models. Also, designer/director relationships, script analysis, research design concepts/history/styles. Students are introduced to a mainstage theatre design.

Credits: 3.0

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

Semesters Offered: Spring - Offered alternate years beginning with the 2000-2001 academic year

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

Pre-Requisite(s): FA 1701 or FA 2820

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 or FA 2701

FA 3703 - Advanced Costume Construction

Building on basic sewing skills and costume technology, students will explore fabrics and more advanced construction techniques: patterning methods such as flat patterning, draping, gridding, pattern alterations for fit and using slopers, construction of historical costumes such as corsets.

Credits: 3.0

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

Semesters Offered: Spring - Offered alternate years beginning with the 2015-2016 academic year

Pre-Requisite(s): FA 1703

FA 3710 - Vocal Approaches for Theatre and Electronic Media

Students will learn vocal approaches to specific types of speaking situations, including radio commercials, instructional videos, announcing, cartoons, and theatrical productions. Students will practice vocal projection for a large theatre/auditorium, as well as microphone technique for electronic media.

Credits: 3.0

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

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

FA 3730 - Sound Design

Introduction to designing sound through design projects. Focuses on fundamental technical understanding, practical design presentation techniques, specific drafting conventions, exploration of sound equipment, designer/director/artist relationships, script analysis and design concepts, and design history.

Credits: 3.0

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

Semesters Offered: Fall

Pre-Requisite(s): FA 1662 and FA 1664 and FA 1702

FA 3731 - Live Sound Design Intensive

Students design, install, program, run, and record a major live production. Sound will be an essential part of the story telling experience requiring a close relationship with the actors and extensive integration with other design elements.

Credits: 1.0

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

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Major(s): Sound Design, Theatre & Entertain Tech (BS), Theatre & Electr. Media Perf., Audio Production & Technology; May not be enrolled in one of the following Class(es): Freshman, Sophomore

Pre-Requisite(s): FA 1662 and FA 1664 and FA 1702 and FA 2662 and FA 3730

FA 3732 - Audio Creative Lab

A creative lab for students interested in the aural arts. Students will be challenged to create sound designs and compositions in response to various aesthetic, dramatic, and philosophical goals for radio, multimedia, and live performance.

Credits: 1.0; Repeatable to a Max of 4

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): FA 1662 and FA 1664 and FA 1702 and FA 3730

FA 3736 - Sound Systems Design and Engineering

Fundamentals of sound systems design & engineering for a variety of entertainment industry scenarios, including: speaker coverage, system tuning, DSP programming, technical documentation, design phases, revision control, interaction with clients, interaction with design teams in other disciplines, and budget estimation.

Credits: 3.0

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

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Major(s): Theatre & Entertain Tech (BS), Sound Design, Audio Production & Technology; May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): FA 1662 and FA 1664 and FA 1702

FA 3740 - Recording

Learning in the art of the recording engineer. Students develop an understanding of pop and classical recording approaches, skills to decide which approach is appropriate for a given task, and the technical knowledge necessary to implement the chosen approach.

Credits: 3.0

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

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Major(s): Sound Design, Theatre & Entertain Tech (BS), Theatre & Electr. Media Perf., Audio Production & Technology

Co-Requisite(s): FA 3741

Pre-Requisite(s): FA 1662 and FA 1664 and FA 1702

FA 3741 - Recording Lab

Hands-on learning in the art of the recording engineer. Students develop an understanding of pop and classical recording approaches, skills to decide which approach is appropriate for a given task, and the technical knowledge necessary to implement the chosen approach.

Credits: 1.0

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

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Major(s): Theatre & Entertain Tech (BS), Sound Design, Audio Production & Technology

Co-Requisite(s): FA 3740

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 or FA 2820

FA 3760 - Costume Design

Fundamentals of designing theatrical costumes through various explorations and projects. Focus on professional design development and presentation techniques: costume renderings, patterning, color/fabric analysis. Also, designer/director relationships, script/character analyses, research, design concepts. Students are introduced to a mainstage theatre design.

Credits: 3.0

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

Semesters Offered: Fall - Offered alternate years beginning with the 2003-2004 academic year

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

FA 3780 - Directing for Theatre

A comprehensive, in-depth study of mounting a theatre production with an emphasis on directing. Through script analysis, students study the necessary production elements, how they interrelate, and directing techniques to create a unified production from the director's vision.

Credits: 3.0

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

Semesters Offered: On Demand

Restrictions: Permission of instructor required

Pre-Requisite(s): FA 2800

FA 3810 - Theatre History I

Study of the Cultural History of Theatre from its likely beginnings through the English Restoration, including traditions of both eastern and western theatre.

Credits: 3.0

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

Semesters Offered: Fall - Offered alternate years beginning with the 2016-2017 academic year

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

FA 3821 - Theatre History II

Study of the Cultural History of Theatre from the end of the English Restoration through the contemporary era.

Credits: 3.0

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

Semesters Offered: Spring - Offered alternate years beginning with the 2016-2017 academic year

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

FA 3830 - The Broadway Musical

A multimedia examination of important works of American musical theatre, how these works have mirrored or shaped our culture, and how New York City has shaped or been shaped by this vibrant art form.

Credits: 3.0

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

Semesters Offered: On Demand

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 2012-2013 academic year

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

FA 3880 - Readings in Dramatic Literature

An examination of dramatic literature with an emphasis on theatre production. Students will examine a selection of plays each semester. Students can repeat the course up to four times; each semester examines different plays.

Credits: 1.0; Repeatable to a Max of 4

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

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Major(s): Sound Design, Theatre & Entertain Tech (BS), Theatre & Electr. Media Perf., Audio Production & Technology; May not be enrolled in one of the following Class(es): Freshman

FA 3975 - Portfolio Development

Techniques for building a professional design and technical portfolio for the theatre and entertainment industry. The final result of the course will be a portfolio of all work to date.

Credits: 1.0

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

Semesters Offered: Fall

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

FA 4150 - Advanced Drawing Studio

Advanced independent exploration and experimentation in drawing theory and use of various drawing media. Students identify a problem or area of interest and develop an approach to it in close consultation with a faculty member, experimenting with a variety of media and methods.

Credits: 3.0; Repeatable to a Max of 6

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

Semesters Offered: Fall, Spring

Restrictions: Permission of instructor required

Pre-Requisite(s): FA 2050 or FA 2150

FA 4200 - Advanced Creative Mixed Media Studio

Advanced work in mixed media such as watercolor, collage, drawing, and/or simple tech. Compositional theory as well as advanced applications of personal expression in mixed media may be included. Emphasis on independence in approach to materials, techniques, and concepts.

Credits: 3.0

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

Semesters Offered: On Demand - Offered alternate years beginning with the 2019-2020 academic year

Restrictions: Permission of instructor required

FA 4300 - Advanced Sculpture Studio

An advanced studio course. Students create works of art inside the student gallery/classroom in the Rozsa, and study traditional & contemporary sculpture. Projects, lectures, readings, and discussions. Focus is on development of the student's personal arts language.

Credits: 3.0; Repeatable to a Max of 6

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

Semesters Offered: Spring - Offered alternate years beginning with the 2019-2020 academic year

Restrictions: Permission of instructor required

Pre-Requisite(s): FA 3333 or FA 3335

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 4620 - Musical Theatre Performance

Provides specialized experience in performance styles of the musical theatre through scene-study and process from sheet music to the stage.

Credits: 3.0

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

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

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

FA 4650 - Production Management for the Entertainment Industry

Focus on techniques to coordinate production and artistic operations for the theatre and entertainment industries and venues. Emphasis on effective event management processes including: safety, budgeting, scheduling, personnel, rehearsals, performance, communication, facilities.

Credits: 3.0

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

Semesters Offered: Spring - Offered alternate years beginning with the 2018-2019 academic year

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

Pre-Requisite(s): FA 3650

FA 4690 - Voice Acting Lessons

Private intensive in voice acting focusing on one specific genre (i.e. audio book narration, radio/television commercials, animated videos, technical narration, IVR messaging, etc.) Course covers basic skills for chosen genre and includes private coaching with the instructor as well as an industry professional.

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 Major(s): Theatre & Electr.

Media Perf.; May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): FA 2830 and FA 3710(C)

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 - Offered alternate years beginning with the 2010-2011 academic year

Pre-Requisite(s): FA 1701

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

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 in Visual and Performing Arts

Independent research directed by Visual and Performing Arts faculty. Projects focus on one or more of the visual and performing genres; theatre, music, visual art. Requires a written proposal setting out goals, plans for final project, and the resources required to complete the project.

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 visual and performing arts.

Credits: variable to 3.0; May be repeated

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 - Visual and Performing 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 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

Finance**FIN 3000 - Principles of Finance**

Introduction to the principles of finance. Topics include financial mathematics, the capital investment decision, financial assets valuation, and the risk-return relationship

Credits: 3.0

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

Semesters Offered: Fall, Spring, Summer

Pre-Requisite(s): (MA 2710 or MA 2720 or MA 3710 or BUS 2100) and ACC 2100(C)

FIN 4000 - Investment Analysis

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): EC 3400 or FIN 3000

FIN 4100 - Advanced Financial Management

Advanced topics in managerial finance: Advanced capital budgeting, project analysis, capital acquisition, capital structure and dividend policy, and other topics.

Credits: 3.0

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

Semesters Offered: Fall

Pre-Requisite(s): EC 3400 or FIN 3000

FIN 4200 - Derivatives and Financial Engineering

Covers the pricing and use of options, financial futures, swaps, and other derivative securities.

Credits: 3.0

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

Semesters Offered: Fall

Pre-Requisite(s): 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

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

Pre-Requisite(s): FIN 3000 or EC 3400

FIN 4500 - Financial Risk Management

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: Spring

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

Pre-Requisite(s): FIN 3000 or EC 3400

FIN 4700 - Global Finance

Studies international financial systems and markets. Covers the principle of comparative advantage, balance of payments, exchange rate systems, theories of international finance, identification of international risk exposures, the management and treatment of risk, and special topics of international finance.

Credits: 3.0

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

Semesters Offered: Fall

Pre-Requisite(s): BA 3400 or EC 3400 or FIN 3000

FIN 4801 - Applied Portfolio Management I

Covers issues in the management and administration of investments in an institutional setting. Students form a new investment firm and manage a real portfolio of financial assets.

Credits: variable to 3.0

Semesters Offered: Summer

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

FIN 4802 - Applied Portfolio Management II

Covers issues in the management and administration of investments in an institutional setting. Students form a new investment firm and manage a real portfolio of financial assets.

Credits: variable to 3.0

Semesters Offered: Fall

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

FIN 4803 - Applied Portfolio Management III

Covers issues in the management and administration of investments in an institutional setting. Students form a new investment firm and manage a real portfolio of financial assets.

Credits: variable to 3.0

Semesters Offered: Spring

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

FIN 4990 - Special Topics in Finance

Examines current issues in Finance and other topics of interest to faculty and students in greater depth.

Credits: variable to 3.0; Repeatable to a Max of 6

Semesters Offered: On Demand

Pre-Requisite(s): EC 3400 or FIN 3000

Forest Resources & Environmental Science**FW 1035 - Wood Anatomy and Properties**

An introduction to the anatomical and physical nature of woody materials and how these characteristics are related to its applications as a sustainable raw material.

Credits: 4.0

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

Semesters Offered: Spring

FW 1050 - The Natural Resource Professional

Seminar introduces students to the various careers within forestry, conservation, ecology, and wildlife that represent specialties within natural resources. Students explore natural resource issues around the world.

Credits: 2.0

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

Semesters Offered: Spring

FW 2010 - Vegetation of North America

Identification of trees and shrubs. Study of seed dispersal, dormancy, and community ecology, with an emphasis on trees. Systematic study of the major forested vegetation types of North America.

Credits: 4.0

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

Semesters Offered: Fall

FW 2030 - Natural Resources Conservation

This course explores the history and evolution of conservation in thought and practice, with an emphasis on the writings and legacy of conservation pioneers such as Aldo Leopold.

Credits: 2.0

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

Semesters Offered: Fall

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

FW 2051 - Field Techniques

Equipment and techniques used in forestry, wildlife, ecology, and recreation management. Topics include field safety, land measurement and navigation, establishment of sample locations, measurement of attributes of individuals and groups of trees, vegetation and other organisms.

Credits: 2.0

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

Semesters Offered: Fall

FW 3010 - Practice of Silviculture

Methods of controlling the establishment, growth, composition, health and quality of forests and woodlands to meet the diverse needs and values of landowners and society on a sustainable basis. Course held at Ford Center, Alberta, MI.

Credits: 4.0

Lec-Rec-Lab: (2-1-3)

Semesters Offered: Fall, Summer

Restrictions: Must be enrolled in one of the following Major(s): Forestry, Wildlife Ecology & Mgmt, App Ecol & Environ Sci

Pre-Requisite(s): FW 2010 and FW 2051

FW 3012 - Survey of Silviculture

An introduction to the practice of silviculture including ecological principles which form the basis for forest management. The course emphasizes proper use of silviculture terminology and includes field examples of management practices. Course held at Ford Center, Alberta, MI.

Credits: 2.0

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

Semesters Offered: Fall, Summer

Restrictions: Must be enrolled in one of the following Major(s): Wildlife Ecology & Mgmt, Natural Resources Management, App Ecol & Environ Sci, Forestry

Pre-Requisite(s): FW 2010 and FW 2051

FW 3020 - Forest Ecology

Environmental factors and plant and animal characteristics which control composition, structure, and function of forest ecosystems. Emphasis on how ecosystems change across space and time and knowledge needed to sustainably manage forest ecosystems for social, economic, and ecological benefits.

Credits: 3.0

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

Semesters Offered: Fall

Pre-Requisite(s): FW 2010(C) and FW 2051(C)

FW 3075 - Introduction to Biotechnology

The course covers basic concepts and practical applications in biotechnology. Topics include the use of biotechnology in agriculture, healthcare, and environmental remediation. Advances in gene containment, regulatory, societal and environmental issues associated with commercialization of biotechnological products will be discussed.

Credits: 3.0

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

Semesters Offered: Spring

FW 3097 - Forest Biomaterials

Examines the nature and use of forest biomaterials and their role in the larger economy. Local and global advantages and challenges for using forest biomaterials will be addressed within the context of sustainability, covering topics such as economics, material and product engineering, policy, life cycle analysis, and supply chain management.

Credits: 3.0

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

Semesters Offered: Fall

FW 3098 - Adding Value to Forest Biomaterials

Examines how forest biomaterials are converted from raw forms into intermediary or final products that can support a sustainable future. Manufacturing sites in the upper Midwest are visited during the week prior to the start of fall semester. Lecture topics include the forest bioeconomy, emerging and export markets, and industry challenges.

Credits: 2.0

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

Semesters Offered: Fall - Offered alternate years beginning with the 2016-2017 academic year

Pre-Requisite(s): FW 1035

FW 3110 - Natural Resource Policy

Covers concepts related to social systems and natural resources. Offers a survey of natural resource policies and organizations. State and federal levels of policymaking will be linked to the human values, attitudes, and beliefs that set the context for natural resource policy processes.

Credits: 3.0

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

Semesters Offered: Spring, Summer

FW 3111 - Wild Foods: Northern Forests

This class engages students in learning practical skills utilizing vegetation of the Boreal Forest for food, medicines, and utilitarian purposes. Emphasis is on exploring the wisdom of the Indigenous peoples of this region. The course provides a basic overview of cultural and historical importance of the interactions between people and plants.

Credits: 2.0

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

Semesters Offered: Summer

FW 3116 - Ethnobotany

The development and variety of plant use across cultures, the transition to commercialization of plants, how current uses are tied to traditional uses, and methods of ethnobotanical research.

Credits: 3.0

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

Semesters Offered: Fall

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

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

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. Course held at Ford Center, Alberta, MI.

Credits: 2.0

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

Semesters Offered: Fall, Summer

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

Pre-Requisite(s): FW 2051

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. Course held at Ford Center, Alberta, MI.

Credits: 1.0

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

Semesters Offered: Fall, Summer

Restrictions: Must be enrolled in one of the following Major(s): Wildlife Ecology & Mgmt, Natural Resources Management, App Ecol & Environ Sci, Forestry

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. Course held at Ford Center, Alberta, MI.

Credits: 2.0

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

Semesters Offered: Fall, Summer

Restrictions: Must be enrolled in one of the following Major(s): Natural Resources Management, 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. Course held at Ford Center, Alberta, MI.

Credits: 3.0

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

Semesters Offered: Fall, Summer

Restrictions: Must be enrolled in one of the following Major(s): Wildlife Ecology & Mgmt, Natural Resources Management, App Ecol & Environ Sci, Forestry

Pre-Requisite(s): FW 2051 and FW 3020 and FW 3200 and (MA 2710 or MA 2720 or MA 3710)

FW 3200 - Biometrics and Data Analysis

Sampling design, implementation and analysis for inventory and monitoring of attributes of stands, forests and landscapes. Includes computing skills for data entry, storage and analysis and application of statistical techniques to answer questions about ecological data.

Credits: 4.0

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

Semesters Offered: Spring

Pre-Requisite(s): FW 2051 and (MA 2710 or MA 2720 or MA 3710)

FW 3313 - Sustainability Science

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: Fall

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

FW 3320 - Fundamentals of Forest Genetics and Genomics

This course will teach fundamental and applied genetic principles that are essential for management of forest and other ecosystems to maintain their long-term health and sustainability. The class will cover the following topics: structure and function of DNA, inheritance, molecular evolution, population and quantitative genetics, gene conservation, genomics and biotechnology.

Credits: 3.0

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

Semesters Offered: Spring

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

FW 3330 - Soil Science

Introduction to the chemical, physical, and biological properties of soil.

Credits: 4.0

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

Semesters Offered: Fall

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

FW 3376 - Forest & Environmental Resource Management (The FERM) I

Application of forest and environmental management practices by teams of students with the assistance of faculty, staff and representatives of state, federal and corporate land management groups as well as non-governmental organizations.

Credits: 2.0; May be repeated

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

Semesters Offered: Fall, Spring, Summer

Pre-Requisite(s): FW 2010 and FW 2051

FW 3377 - Forest & Environmental Resource Management (The FERM) II

Application of forest and environmental management practices by teams of students with the assistance of faculty, staff, and representatives of state, federal, and corporate land management groups as well as non-governmental organizations.

Credits: 3.0; May be repeated

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

Semesters Offered: Fall, Spring, Summer

Pre-Requisite(s): FW 2010 and FW 2051

FW 3410 - Conservation Biology

Introduction to biological, social, political, and economic facets of conservation biology. Emphasizes evaluation of how best to maintain and restore biodiversity through management of populations and ecosystems. Topics include mass extinctions, global change, loss and degradation of habitat, and over exploitation of biological resources.

Credits: 3.0

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

Semesters Offered: Spring

FW 3510 - Outdoor Recreation and Tourism

Covers background on Americans and leisure; overview of primary providers of recreation in the US; management of outdoor recreation, measuring and valuing outdoor recreation and tourism; recreation and tourism in the Great Lakes region. Requires participation in field trips/workshops.

Credits: 3.0

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

Semesters Offered: Spring

FW 3540 - An Introduction to Geographic Information Systems for Natural Resource Management

The fundamentals of GIS and its application to natural resource management. Spatial data, its uses and limitations are evaluated. Students work extensively with the ARCGIS software package.

Credits: 4.0

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

Semesters Offered: Spring

Pre-Requisite(s): MA 2710(C) or MA 2720(C) or MA 3710(C) or ENVE 3502 or CEE 3502(C)

FW 3600 - Wildlife Habitat

Understand the ecological basis for management of forest wildlife and how forest management influences wildlife populations. Laboratory introduces techniques in wildlife research and management, especially methods of habitat analysis.

Course held at Ford Center, Alberta, MI.

Credits: 3.0

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

Semesters Offered: Fall, Summer

Restrictions: Must be enrolled in one of the following Major(s): Wildlife Ecology & Mgmt, Natural Resources Management, App Ecol & Environ Sci, Forestry; 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: (0-0-2)

Semesters Offered: Summer

FW 3640 - Aquatic Ecosystems

Students will be introduced to aspects of lake and stream ecosystems. Field trips will focus on sampling abiotic and biotic characteristics of aquatic ecosystems especially in regard to land use and management and conservation. Course held at Ford Center, Alberta, MI.

Credits: 2.0

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

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Major(s): Natural Resources Management; May not be enrolled in one of the following Class(es): Freshman

FW 3760 - Human Dimensions of Natural Resources

Uses sociological concepts to cover facets of human relationships to natural resources, including human values, beliefs, and attitudes regarding the environment; rural resource-dependent communities; natural resource professions and expert knowledge; and the history of American perspectives on the environment.

Credits: 3.0

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

Semesters Offered: Fall

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

FW 3765 - Maple Syrup Management and Culture

Overviews cultural and historical importance of syrup production. Topics include methods of collecting and processing sap, syrup, sugar, and business marketing of maple products. Course includes one day field experience.

Credits: 1.0

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

Semesters Offered: Spring

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

FW 3800 - Insect Ecology

Insects are widespread and diverse components of terrestrial and aquatic ecosystems. This course will consider aspects of insect ecology, including biodiversity and conservation of insects, the effects of biotic and abiotic factors on insect populations, and the trophic diversity of insects. Course held at Ford Center, Alberta, MI.

Credits: 2.0

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

Semesters Offered: Fall, Summer

Restrictions: Must be enrolled in one of the following Major(s): Wildlife Ecology & Mgmt, App Ecol & Environ Sci

FW 3840 - Forest Health

Drawing on examples from the Great Lakes region, and other parts of North America, this course will consider which type of insects and pathogens attack our trees and forests, how they interact with each other, and what tools we can use to effectively reduce their negative impacts of forest pests. Course held at Ford Center, Alberta, MI.

Credits: 3.0

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

Semesters Offered: Fall, Summer

Restrictions: Must be enrolled in one of the following Major(s): Wildlife Ecology & Mgmt, Natural Resources Management, App Ecol & Environ Sci, Forestry
Pre-Requisite(s): FW 3020

FW 4000 - Professional Experience Program

Students create oral/written reports and reflection 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 & 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 4082 - Gene Expression Data Analysis

This course is designed for students majoring in molecular biology, computer science, data science and related majors to develop fundamental but essential skills for manipulating, preprocessing, and analyzing high throughput gene expression data for pattern extraction and knowledge discovery.

Credits: 3.0

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

Semesters Offered: Fall - Offered alternate years beginning with the 2018-2019 academic year

Restrictions: May not be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): FW 4099 or CS 1121 or CS 1122 or CS 1131 or CS 1141 or CS 2321

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.

Credits: 3.0

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

Semesters Offered: Fall - Offered alternate years beginning with the 2017-2018 academic year

Pre-Requisite(s): CS 1121

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

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

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 - Stand & Forest Modeling

Use of models that simulate tree, stand, and forest development. Emphasis on critical evaluation of model designs, outputs, uses in silvicultural decision-making, and forest to landscape management and planning.

Credits: 2.0

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

Semesters Offered: Spring

Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): FW 3010 or FW 3012 and FW 3540(C)

FW 4150 - Forest and Natural Resource Management

Focuses on forest and natural resources management planning and decision making. Emphasizes structured problem solving frameworks and decision support tools/models. Three field trips to meet with natural resources professionals and discuss site-specific management issues and approaches.

Credits: 3.0

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

Semesters Offered: Fall

Pre-Requisite(s): FW 3010 or FW 3012

FW 4151 - Advanced Timber Harvesting

Quantitative methods for evaluation of time harvesting systems, equipment, and transportation. Emphasizes detailed logging cost analysis, machine rates, depreciation, productivity, and optimization. Includes use of software, GIS, and systems of equations.

Credits: 3.0

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

Semesters Offered: Spring

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

Pre-Requisite(s): FW 3150

FW 4170 - Consulting Forestry

For students who are considering consulting forestry as a career. Covers issues specific to working with private landowners, stewardship plan writing, choosing a business entity, marketing, taxes, income/expenses, insurance, timber sale administration, and resolving landowner disputes.

Credits: 2.0

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

Semesters Offered: Spring

FW 4180 - Natural Resources, Ethics, and the Environment

Discusses relationship between ecological science and environmental ethics as it relates to natural resource management.

Credits: 2.0

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

Semesters Offered: Fall

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

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

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

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.

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

FW 4250 - The Wolves and Moose of Isle Royale

Wolves and moose have been studied for 50 years on Isle Royale, a wilderness island in Lake Superior. The instructor leads this research and uses the research to explain predation, population dynamics, conservation genetics, and other ecological principles.

Credits: 2.0

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

Semesters Offered: Fall - Offered alternate years beginning with the 2018-2019 academic year

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 fire history, fuel properties, fire weather, 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

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

FW 4371 - Snow Hydrology

This course will cover snow formation in the atmosphere, snow accumulation and distribution, snow metamorphism, avalanche dynamics, snowmelt and runoff, remote sensing of snow properties, and the impact of forests and under-snow biogeochemical processes.

Credits: 3.0

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

Semesters Offered: Spring - Offered alternate years beginning with the 2018-2019 academic year

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

Pre-Requisite(s): MA 2710 or MA 2720

FW 4380 - Landscape Ecology and Planning

Basic principles of landscape ecology, including pattern, process, and scale. Students will learn how to use quantitative tools to study landscape-scale patterns and processes, and how to apply these principles and tools to conservation, resource management, and planning issues.

Credits: 3.0

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

Semesters Offered: Spring

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

FW 4400 - Urban Forestry

Urban forestry is the science and art of managing natural resources in communities. It focuses on maximizing the wide range of economic, environmental, and social benefits associated with trees and urban greenspaces while minimizing maintenance costs and reducing tree-related risks.

Credits: 3.0

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

Semesters Offered: Spring

FW 4401 - Urban Forestry Lab

The urban forestry field lab is a two-day tour held in Chicago for students to interact with and learn from professionals in the green industry, arboriculture, and urban forestry. It coincides with the Midwest Urban Tree Care Forum in mid-April.

Credits: 1.0

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

Semesters Offered: Spring

Pre-Requisite(s): FW 4400(C)

FW 4500 - Independent Study

Guided study or research on an approved forest resource or other natural 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

Remote sensing principles and concepts. Topics include camera and digital sensor arrays, types of imagery, digital data structures, spectral reflectance curves, applications, and introductory digital image processing.

Credits: 3.0

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

Semesters Offered: Fall

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

FW 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 2017-2018 academic year

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

Pre-Requisite(s): FW 3540 or FW 5550

FW 4610 - Wildlife Ecology

Covers the ecological basis for management of wildlife, including biological and sociological factors that influence management.

Credits: 3.0

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

Semesters Offered: Fall

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

Pre-Requisite(s): BL 3400(C) or FW 3020(C)

FW 4620 - Herpetology

The biology of amphibians and reptiles, including evolution, zoogeography, ecology, behavior and physiology.

Credits: 3.0

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

Semesters Offered: Spring - Offered alternate years beginning with the 2018-2019 academic year

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

FW 4710 - Environmental Biogeochemistry

Impacts of decisions regarding landuse, land management, and energy and mineral exploration on natural resources (i.e., air, water, land, and biodiversity) are discussed using the framework of the biogeochemical cycles of the elements.

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): CH 1150

FW 4800 - Communication for Natural Resource Professionals

This class completes the development of oral and written communication skills for students as they prepare to graduate and gain employment in the field of natural resources.

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, Sophomore, Junior

Pre-Requisite(s): FW 3190

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 4811 - Integrated Resource Assessment Data Collection

Students will collect field data needed for writing their Integrated Resource Assessment management plans. Field skills and ability to summarize and display data will be assessed. Students will develop appropriate sampling designs, collect needed field data with acceptable error limits, and summarize the data.

Credits: 1.0

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

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Major(s): Wildlife Ecology & Mgmt, Natural Resources Management, App Ecol & Environ Sci, Forestry

Pre-Requisite(s): FW 3190

FW 4830 - Integrated Natural Resource Assessment

Course provides a capstone experience by integrating techniques from many of the forestry, applied ecology, wildlife ecology, and natural resources management core courses. Culminates in the development of management plans for various natural resource alternatives.

Credits: 3.0

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

Semesters Offered: Spring

Pre-Requisite(s): FW 4811

FW 4840 - Senior Research Thesis

An independent study or research project on an approved topic in Forestry, Applied Ecology and Environmental Sciences, Wildlife Ecology, or Natural Resource Management, under the guidance of a faculty member. Available only to students in their graduating year.

Credits: 4.0

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

Semesters Offered: Fall, Spring

Restrictions: Permission of instructor required; Must be enrolled in one of the following Class(es): Senior

Pre-Requisite(s): FW 3190

Geological & Mining Engineering & Sciences**GE 1100 - Geological Engineering and Sciences Orientation**

Introduction to geosciences as a profession, including discussions of career opportunities and geoscience programs. Earth materials and the earth's processes are also introduced. Includes frequent field trips. Intended for freshman or sophomore students in geological engineering, geology, applied geophysics, hydrology, geotechnics, earth science teaching, or any other geoscience program.

Credits: 1.0; Graded Pass/Fail Only

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

Semesters Offered: Fall

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

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: 3.0

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

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

GE 2100 - Environmental Geology

Introduction and study of current environmental issues related to the earth sciences. Covers major topics such as volcanism, earthquakes, shoreline erosion, and pollution of groundwater as multi-week modules with associated labs, lectures, and field projects.

Credits: 3.0

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

Semesters Offered: Spring

GE 2300 - Mineral Science

Introduction to the study of minerals including chemical composition, crystal structure, physical properties, identification, and controls on and environments of formation. Laboratory focuses on hand specimen identification of minerals and includes introduction to X-ray diffraction and SEM mineral analysis techniques.

Credits: 3.0

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

Semesters Offered: Fall

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

Pre-Requisite(s): CH 1000 or CH 1112 or (CH 1150 and CH 1151)

GE 2310 - Introduction to Petrology

Identification, physical properties, chemical composition, occurrence, and origin of the important types of igneous, sedimentary, and metamorphic rocks. Laboratory includes hand specimen description and identification of rocks.

Credits: 3.0

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

Semesters Offered: Spring

Pre-Requisite(s): GE 2300

GE 2320 - Mining Methods and Systems

This course presents a study of the surface and underground mining methods practiced in coal, metal, and aggregate mine operations, classification of mining methods, support design and equipment selection, general mine planning requirements, mine development sequence, cycle of operations, and method application.

Credits: 3.0

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

Semesters Offered: Spring

Pre-Requisite(s): GE 2020

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 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: Spring

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

GE 3250 - Computational Geosciences

Introduction to quantitative analysis and display of geologic data using R/Matlab, covering basic R/Matlab syntax and programming, and analysis of one-dimensional (e.g. time series) and two-dimensional datasets (i.e. spatial data). Techniques are applied to geological datasets.

Credits: 3.0

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

Semesters Offered: Spring

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

Pre-Requisite(s): MA 1160 or MA 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 3430 - Geomechanics Laboratory

This course includes laboratory experiments to determine physical and mechanical properties of rocks including harness, tensile and compressive strength and stress, point load index, tri-axial tests, and slake durability test.

Credits: 1.0

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

Semesters Offered: Fall, Summer

Pre-Requisite(s): GE 2020 and GE 2320

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, Spring

GE 3860 - Engineering Geology and Geoinformatics

Engineering geology relates the geologic factors with the location, design, construction, and maintenance of engineering projects and ensures they are accounted. Students will also be introduced to the fundamental concepts and components of geographic information systems (GIS) for engineering.

Credits: 3.0

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

Semesters Offered: Fall

Pre-Requisite(s): GE 2000 or GE 2100 and (GE 3050 or ENG 2120 or MEEM 2150)

GE 3870 - Resource & Reserve Estimation

This course covers the classification of resource and reserve; resource estimation algorithms; linear, nonlinear, and indicator kriging; stochastic simulation; variogram modeling; block-variance relationship; recoverable reserve; and introduction to resource estimation software.

Credits: 3.0

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

Semesters Offered: Fall - Offered alternate years beginning with the 2016-2017 academic year

Pre-Requisite(s): GE 2020 and MA 3710

GE 3880 - Mine Planning and Design

Course provides the basics of mine planning, feasibility study, block modeling, economic analysis, cost estimation and price forecasting, mining method selection algorithms. Introduction and hands-on experience with mine planning and design software including Surpac, Vulcan, and Whittle.

Credits: 3.0

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

Semesters Offered: Spring

Pre-Requisite(s): GE 2320 and GE 3400 and GE 3870

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 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 4130 - Petroleum Geology

Basic elements of petroleum geology, including the composition of crudes, exploration, subsurface techniques, petroleum migration, seals, traps, and types of gas and oil plays. Students will study geologic factors that control the genesis of major gas and oil fields, such as the Persian Gulf, California, and US Gulf Coast.

Credits: 3.0

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

Semesters Offered: Spring

Pre-Requisite(s): GE 2000 and GE 2300 and GE 2310

GE 4150 - Natural Hazards

This course focuses on current mitigation agencies and warning systems, case studies of successes and failures in hazard mitigation, and technical tools for hazard study and mitigation such as satellite remote sensing and GIS.

Credits: 3.0

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

Semesters Offered: Fall

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

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

GE 4180 - Volcanology

Volcanoes and how they work. Volcanic eruption styles and products, their recognition, and significance. Volcanic hazards, volcano monitoring and impacts of volcanism on the environment, climate and society. Applies chemistry, physics, and fluid mechanics in a volcanological context.

Credits: 3.0

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

Semesters Offered: Fall

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

Pre-Requisite(s): GE 2000 and (MA 1160 or MA 1161)

GE 4190 - Magma Reservoir Dynamics

Introduction to topics in advanced igneous petrology emphasizing processes that occur in magma reservoirs. Includes the application and integration of geochemistry, petrology, and geochronology to investigate magma dynamics and their influence on frequency, style, and magnitude of eruptions.

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): GE 2300 and GE 2310

GE 4240 - Surface Geophysics

Application of near surface geophysical methods to environmental and geological investigations through field work and case studies. An emphasis will be placed on ground penetrating radar, but will include other methods such as electrical resistivity, induced polarization, magnetics, and horizontal loop electromagnetics.

Credits: 3.0

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

Semesters Offered: Fall

Pre-Requisite(s): GE 3040 and GE 3900

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 4290 - Mine Ventilation, Health, and Safety Engineering

Course deals with an introduction to mine ventilation, properties of air, gases, and dust, mine fans and its applications, flow distribution in mine network, computer analysis of ventilation network, mine health and safety overview, health and safety culture and practice.

Credits: 3.0

Lec-Rec-Lab: (0-0-9)

Semesters Offered: Summer - Offered alternate years beginning with the 2016-2017 academic year

Pre-Requisite(s): GE 2020 and GE 2320 and ENG 3200

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

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 or CEE 3501 or CEE 3503

GE 4530 - Planetary Geology & Geophysics

Geological, geophysical, and geochemical processes in the Solar System are examined. Topics include the formation and evolution of the Solar System, planetary surface processes and water distribution, impact structures, composition, structure, and dynamics of planetary interiors, geophysical exploration of planets.

Credits: 3.0

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

Semesters Offered: Fall

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

Pre-Requisite(s): GE 2000 and PH 2200 and MA 2160

GE 4560 - Earthquake Seismology

Course covers fundamentals of the physics of earthquakes and seismic energy propagation, and seismic methods to determine Earth structure. Emphasis is placed on natural source techniques, with extension to exploration applications. Weekly labs apply techniques.

Credits: 3.0

Lec-Rec-Lab: (2-0-2)

Semesters Offered: Fall

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

Pre-Requisite(s): GE 3050 and PH 2100 and MA 3160

GE 4600 - Reflection Seismology

Principles of reflection seismic techniques, including theoretical background and application, and hands-on computer projects. Included are acquisition, data processing, and 2D/3D data interpretation. Students conduct projects using actual commercial-quality seismic data.

Credits: 3.0

Lec-Rec-Lab: (2-1-0)

Semesters Offered: Spring

Pre-Requisite(s): GE 3040

GE 4610 - Formation Evaluation and Petroleum Engineering

Principles and practice of formation evaluation, primarily through analysis of well logs and the principles and practice of petroleum engineering. Emphasizes reservoir engineering and simulation. Students conduct projects using actual field data.

Credits: 3.0

Lec-Rec-Lab: (2-1-0)

Semesters Offered: Fall, Spring

GE 4620 - Energy Economics

Introduction to the institutional, technical, and economic issues of the production and use of energy resources, including petroleum, natural gas, coal, nuclear, electric utilities, and alternative energy sources. Applies economic analysis to industrial and policy problems of the supply, distribution, and use of energy resources, including environmental and social consequences.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring

Pre-Requisite(s): EC 2001 or EC 3002 or EC 3003

GE 4630 - Mineral Industry Economics

Studies the role of minerals and metals in society and the economics of their use. Applies economic principles to examine the supply, demand, markets, and foreign trade for important minerals and metals. Examines the effect of government policies on the minerals industries. Requires a technical report.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall, Spring - Offered alternate years beginning with the 2009-2010 academic year

Pre-Requisite(s): EC 2001 and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

GE 4640 - Fundamentals of Atmospheric Science

Fundamental principles of atmospheric science, including thermodynamics, aerosol and cloud physics, radiative transfer, and atmospheric dynamics.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2013-2014 academic year

Pre-Requisite(s): (PH 2200 or PH 2260) and (PH 1360 or PH 2300) and MA 3160 and (MA 3520 or MA 3521 or MA 3530 or MA 3560)

GE 4680 - Operation Research for Mining Engineers

This course introduces the statistical analysis of mining data, statistical decision making of mining projects, random number generation, Monte Carlo methods, simulation methods, linear and integer programming, queueing theory, stochastic-process, PERT and CPM, applications of operations research (OR) in mining and mineral industry.

Credits: 3.0

Lec-Rec-Lab: (2-0-2)

Semesters Offered: Fall, Spring - Offered alternate years beginning with the 2016-2017 academic year

Pre-Requisite(s): GE 2020 or GE 2320

GE 4690 - Discrete Event Simulation and Animation for Engineers

This course focuses on discrete-event system simulation and animation techniques in modeling engineering projects, in particular mining projects.

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): GE 2020 and GE 2320 and GE 3870

GE 4700 - Geologic Mapping of Remote Terrain

An introduction to the use of GIS (Geographic Information Systems) in geologic mapping. Uses remotely acquired data (e.g. Landsat) to produce geologic maps, cross sections, and make measurements such as strike and dip. Students work with both public domain programs (QGIS) and commercial packages (Arc Map) and emphasize the GIS aspects.

Credits: 3.0

Lec-Rec-Lab: (0-2-1)

Semesters Offered: Spring

GE 4720 - GIS Applications in Geology

An introduction to the application of GIS to the geological sciences with emphasis on the characterization of rocks, minerals, and geologic structures using satellite imagery and elevation (DEM) data. Students will work with modern GIS software packages.

Credits: 4.0

Lec-Rec-Lab: (3-0-1)

Semesters Offered: Fall

Pre-Requisite(s): GE 2000

GE 4735 - Igneous Petrology

An examination of the origin of a variety of igneous rocks from different tectonic environments using geochemistry, mineralogy, and rock textures.

Credits: 3.0

Lec-Rec-Lab: (2-0-3)

Semesters Offered: Spring

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

Pre-Requisite(s): GE 2300 and GE 2310

GE 4760 - Geology and Exploration for Mineral Deposits

Geology, geologic evaluation, and exploration for mineral resources with emphasis on metals. Course covers geologic characteristics of a variety of classes of mineral deposits, design of exploration programs, design of drilling programs, concepts of resource estimation, and reporting requirements. Laboratory includes study of specimens from specific localities and simulated subsurface exploration.

Credits: 3.0

Lec-Rec-Lab: (2-0-3)

Semesters Offered: Fall

Pre-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 for Slope Stability and Geomechanics

Computer methods for the design problems encountered in geomechanics. Applications to be selected from slope stability, earth retention systems, and seepage. Students will be introduced to limit equilibrium and finite element analysis through theory and computational labs.

Credits: 3.0

Lec-Rec-Lab: (2-0-3)

Semesters Offered: Spring

Pre-Requisite(s): GE 3860 or CE 3810 or CEE 3810

GE 4900 - Capstone I

Capston engineering design course focusing on a realistic, complex, open-ended engineering problem. Project includes technical design, economic analysis, environmental impacts, and regulations. Report writing required. (Senior project ready as defined by major substitutes for prerequisites).

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

GE 4910 - Capstone II

Capstone engineering design course focusing on a realistic, complex, open-ended engineering problem. Project includes technical design, economic analysis, environmental impacts, and regulations. Report writing required. (Senior project ready as defined by major substitutes for prerequisites).

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

Pre-Requisite(s): GE 4900

GE 4916 - Field Geology in East and South Africa

Introduction to methods and problems of field geology. Data gathering and interpretation of field relationships using Brunton, GPS LandSat, etc. in East Africa. Requires geological report and digital maps.

Credits: 6.0

Lec-Rec-Lab: (0-0-18)

Semesters Offered: Spring, Summer

Restrictions: Permission of instructor required

Pre-Requisite(s): GE 3050

GE 4930 - Special Topics in Geological Engineering

Study and discussion of geological engineering topics.

Credits: variable to 5.0; Repeatable to a Max of 10

Semesters Offered: On Demand

Restrictions: Permission of instructor required

GE 4931 - Special Topics in Geology

Study and discussion of geology topics.

Credits: variable to 5.0; Repeatable to a Max of 10

Semesters Offered: On Demand

Restrictions: Permission of instructor required

GE 4933 - Special Topics in Geophysics

Study and discussion of geophysics topics.

Credits: variable to 5.0; Repeatable to a Max of 10

Semesters Offered: On Demand

Restrictions: Permission of instructor required

GE 4934 - Special Topics in Mining Engineering

Study and discussion of topics in mining engineering not included in regular undergraduate courses.

Credits: variable to 5.0; Repeatable to a Max of 10

Semesters Offered: On Demand

GE 4961 - Independent Geology Research Project

Approved literature, laboratory, and/or field geology research problem originated by the student or assigned by the instructor. A final report is required.

Credits: variable to 9.0; Repeatable to a Max of 9

Semesters Offered: On Demand

Restrictions: Permission of instructor required; May not be enrolled in one of the following Class(es): Freshman, Sophomore

GE 4962 - Independent Geophysics Research Project

Approved literature, laboratory, and/or field geophysics research problem originated by the student or assigned by the instructor. A final report is required.

Credits: variable to 9.0; Repeatable to a Max of 9

Semesters Offered: On Demand

Restrictions: Permission of instructor required; May not be enrolled in one of the following Class(es): Freshman, Sophomore

GE 4970 - Special Topics in Global Environment Change

Course will focus on emerging topics on global environment change including changes in atmospheric composition and air quality, air pollution meteorology, extreme meteorological events, and ocean chemistry. Anthropogenic contributions to these changes will be presented and analyzed. Students will work on projects based on historical records from multiple datasets to evaluate and appreciate the long-term changes in the global environment and better understand the perturbations due to human activities.

Credits: 3.0; Repeatable to a Max of 6

Lec-Rec-Lab: (2-1-0)

Semesters Offered: Fall, Spring

Pavlis Honors

HON 1150 - Creating Your Path

This course will guide students in the application of life design methods to create a path toward achievement of personal education, career & life goals. By applying a combination of activities, discussion, & reflection to principals of design thinking, problem solving, creativity, & communication, students will develop a framework for life success.

Credits: 1.0

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring

Restrictions: Permission of department required; Must be enrolled in one of the following Class(es): Freshman, Sophomore

HON 2150 - Pavlis Seminar I

The first of three seminars designed for the Pavlis Honors College Experiential Learning Communities. Students are introduced to program requirements and engage in an active and reflective learning environment to explore personal and social identities, teamwork, culture, and perspectives

Credits: 1.0

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring

Restrictions: May not be enrolled in one of the following Class(es): Freshman

HON 2200 - Leadership, Culture, and Technology

This course provides students with an understanding of the nature and process of leadership, and an opportunity to assess personal leadership skills/potential and develop a personal model of leadership. Leadership in other cultures and use of appropriate technology will also be explored.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall, Spring

Restrictions: Permission of instructor required

HON 2990 - Interdisciplinary Special Topics in Honors

Study of interdisciplinary special topics as specified by section title.

Credits: variable to 6.0; Repeatable to a Max of 6

Semesters Offered: On Demand

Restrictions: Permission of instructor required

HON 3060 - Honors Practicum

Reflective practicum for students fulfilling the immersion requirement in a Pavlis Honors College Experiential Learning Community.

Credits: variable to 12.0; Repeatable to a Max of 12

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): HON 2150 and HON 3150

HON 3150 - Pavlis Seminar II

The second of three seminars designed for Pavlis Honors College Experiential Learning Communities. Students engage in telling their stories to different audiences, learn about personal leadership, and craft a personal leadership vision statement.

Credits: 1.0

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): HON 2150 and UN 1015 and (UN 1025)

HON 3300 - Innovation through Human Centered Design

This course introduces students to the processes and tools associated with Human Centered Design (HCD). HCD is a key process used in identifying needs/opportunities and innovative solutions.

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

HON 3410 - Culture, Language, & Project Development

Course is designed to help students gain culture and language awareness for their int'l travel to project sites in Ghana, India, Tanzania, Brazil, or Senegal. Students will gain insight working with and learning from different cultures to see the world and their leadership in new ways and will refine/finalize projects they will implement in country.

Credits: 3.0

Lec-Rec-Lab: (2-0-3)

Semesters Offered: Summer

Restrictions: Permission of department required; May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): UN 1015 and (UN 1025)

HON 3990 - Interdisciplinary Special Topics in Honors

Study of interdisciplinary special topics as specified by section title.

Credits: variable to 6.0; Repeatable to a Max of 6

Semesters Offered: On Demand

Restrictions: Permission of instructor required

HON 4060 - International Leadership Practicum

Students traveling internationally in the Pavlis program will plan and direct a project abroad and spend time abroad participating in a variety of leadership and cultural awareness experiences.

Credits: variable to 9.0

Semesters Offered: Summer

Pre-Requisite(s): UN 3410(C)

HON 4070 - Leadership Practicum

Course designed for students pursuing the Leadership Minor, allows for a non-international leadership practicum experience, and the practical application of leadership knowledge, skills and behaviors, and development of leadership experience. The practicum experience will be designed and implemented by the student, with mentorship/guidance from the associated faculty.

Credits: variable to 9.0

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of department required; May not be enrolled in one of the following Class(es): Freshman, Sophomore

Pre-Requisite(s): HON 2200 or MGT 3100 or AF 3001

HON 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, Spring

Restrictions: Must be enrolled in one of the following Class(es): Senior

Pre-Requisite(s): UN 4060

HON 4150 - Pavlis Seminar III

The final of three seminars designed for the Pavlis Honors College Learning Community. Students engage in difficult dialogues, decision making, critical thinking, ethics, and goal setting while they synthesize their honors college experience.

Credits: 1.0

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): HON 3150 and UN 1015 and (UN 1025)

HON 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: Fall, Spring

Restrictions: Must be enrolled in one of the following Class(es): Senior

Pre-Requisite(s): UN 4060 and (HON 4100(C) or UN 4100)

HON 4300 - Introduction to the Fundamentals of Social Innovation and Social Entrepreneurship

In this introductory course, students will be exposed to the key concepts and practices around social innovation and entrepreneurship. They will learn about different approaches to social entrepreneurship and strengths and weaknesses of various models and strategies. All students will participate in the Social Innovation Challenge Competition at semester end.

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

HON 4990 - Interdisciplinary Special Topics in Honors

Study of interdisciplinary special topics as specified by section title.

Credits: variable to 6.0; Repeatable to a Max of 6

Semesters Offered: On Demand

Restrictions: Permission of instructor required

Humanities

HU 0110 - Undergraduate Student Coaching

Schedule weekly appointments with a writing coach to strengthen writing and reading effectiveness in any course except Composition. Specialized assistance available to students who speak English as a Second Language, students who have learning disabilities and students who are undergraduate writing coaches. Credits do not count toward graduation.

Credits: 0.0; May be repeated

Semesters Offered: Fall, Spring, Summer

HU 0122 - Global Issues Study Team

Students who are enrolled in Global Issues (UN1025) may sign up for a study team led by a writing center coach. Teams meet twice weekly. The meetings address the challenges of the Global Issues course as well as develop students' effectiveness working in teams. Strongly recommended for students with English/Reading ACT of 20 or below. Credits do not count toward graduation.
Credits: 0.0; May be repeated
Semesters Offered: Fall, Spring, Summer
Co-Requisite(s): UN 1025

HU 0123 - Composition Coaching

Scheduled weekly appointment with a writing coach to improve writing and reading effectiveness in Composition (UN1015). Strongly recommended for students with English ACT of 20 or below. Credits do not count toward graduation.
Credits: 0.0; May be repeated
Semesters Offered: Fall, Spring, Summer
Co-Requisite(s): UN 1015

HU 0124 - Graduate Student Coaching

Scheduled weekly appointment with a writing coach to improve writing and reading effectiveness in graduate courses and to address the challenges of writing theses and dissertations. Credits do not count toward graduation.
Credits: 0.0; May be repeated
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate

HU 0125 - Int'l GTA Assistance Program

International graduate students can enroll in HU0125 to work on cultural differences in presentation skills and to practice speaking instructional English. These students will meet weekly in group and individual settings to improve their facility as speakers of English. Credits do not count toward graduation.
Credits: 0.0; May be repeated
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate

HU 2130 - Introduction to Rhetoric

Focuses on historical origins, cultural adaptations, and contemporary relevance of rhetorical traditions.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring

HU 2201 - Level I-A Chinese Language and Culture

Introduction to basic Chinese grammar, vocabulary, and idiomatic expressions, designed to help students acquire the basics of oral and written Chinese. Includes study of contemporary Chinese culture.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Senior

HU 2202 - Level I-B Chinese Language and Culture

Further study of Chinese grammar, vocabulary, and idioms with emphasis on conversation and communicative strategies. Includes continued study of Chinese culture.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Pre-Requisite(s): HU 2201 or Language Placement Chinese >= 100

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: variable to 5.0
Semesters Offered: On Demand
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: variable to 5.0
Semesters Offered: On Demand
Pre-Requisite(s): HU 2241

HU 2271 - Level I-A French Language and Culture

Introduction to basic French grammar, vocabulary, and idioms designed to help students acquire the basics of oral and written French. Includes study of contemporary French-speaking cultures.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Restrictions: May not be enrolled in one of the following Class(es): Senior

HU 2272 - Level I-B French Language and Culture

Further study of French grammar, vocabulary, and idioms with continued practice of conversation and basic readings in French. Continued study of contemporary French speaking cultures.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): HU 2271 or Language Placement French >= 131

HU 2273 - Transitional Level I French Language and Culture

Intensive study of basic French grammar, vocabulary, and culture. Designed to prepare students with minimum essentials of oral and written French for intermediate and advanced level work. Students completing this course may apply for placement credits.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Pre-Requisite(s): Language Placement French >= 201

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
Restrictions: May not be enrolled in one of the following Class(es): Senior

HU 2282 - Level I-B German Language and Culture

Further study of the basics of the German language acquainting students with the essentials of oral and written German, with emphasis on conversational skills. Includes continued discussion of cultures and societies of contemporary German-speaking Europe.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Pre-Requisite(s): HU 2281

HU 2291 - Level I-A Spanish Language and Culture

Introduction to basic Spanish grammar, vocabulary, and idioms, designed to help students acquire the basics of oral and written Spanish. Includes study of contemporary Spanish-speaking cultures.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
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: On Demand
Pre-Requisite(s): HU 2291 or Language Placement Spanish >= 131

HU 2293 - Transitional Level I Spanish Language and Culture

Intensive review of basic Spanish grammar, vocabulary, and culture. Designed to prepare students with minimum essentials of oral and written Spanish for intermediate and advanced level work. Students completing this course may apply for placement credit.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring, Summer
Pre-Requisite(s): HU 2291 or Language Placement Spanish >= 201

HU 2324 - Introduction to Film

Focuses on critical engagement with cinematic form and its relationship to cultural, historical, and/or theoretical contexts.
Credits: 3.0
Lec-Rec-Lab: (2-0-3)
Semesters Offered: Fall

HU 2500 - Ways of Reading

This course introduces students to reading strategies, critical vocabularies, and critical writing practices. Individual sections will center on a unifying question or problem, emphasizing attentive reading, critical thinking, and qualitative interpretation of literary texts.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall

HU 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 - Offered alternate years beginning with the 2017-2018 academic year

HU 2503 - Introduction to Literature

Survey of transnational or transatlantic literary traditions, highlighting select historical periods such as Romanticism, and/or movements, such as the Harlem Renaissance.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring

HU 2505 - Science, Technology, and Humanities

A survey using literary texts, narrative history, documentary evidence, film, music, and cross-cultural references to contextualize the emergence of scientific, technological, and humanistic developments in the modern era.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand - Offered alternate years beginning with the 2000-2001 academic year

HU 2510 - Intro to Creative Writing

An introduction to creative writing with readings in contemporary and emerging literatures. Genres covered may include fiction, nonfiction, poetry, and screenplay. This course stresses individual production through process-oriented writing exercises, small group workshops, individual conferences, and creative theory.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, 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 2016-2017 academic year

HU 2548 - Young Adult Literature

Reading, reflecting on, and responding to age-appropriate adolescent literature. Works include authors from different races, cultures, historical periods, and genders. Discussion may be supplemented with films. Appropriate for students who plan to be parents, community volunteers, and teachers.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

HU 2600 - Introduction to the Field of Scientific and Technical Communication

An introduction to the history, theory, and practice of scientific and technical communication as preparation for future study.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Major(s): Scientific & Tech Comm (BS), Scientific & Tech Comm (BA)

HU 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: On Demand

HU 2633 - Fundamentals of Digital Imaging

Explores the history, aesthetic, theory, and practice of digital imaging. Students learn to find, make, and analyze images.

Credits: 3.0

Lec-Rec-Lab: (0-2-1)

Semesters Offered: Fall, Spring

HU 2642 - Introduction to Digital Media

Basic principles, practices and implications of digital media communication and production. Provides foundation in tools, techniques and processes through hands-on production, readings, discussion and analysis of contemporary issues related to digital media.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring

HU 2645 - Graphic and Information Design

A computer-intensive introduction to the principles for creating clear, effective graphic communication. Students critique the work of other designers in terms of the work's audience and intended effect, and they construct and critique their own design projects as well.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

HU 2700 - Introduction to Philosophy

A study of thought representing various traditions such as classical and contemporary philosophy, Eastern and Western religion, and issues in recent science. Some basic concepts of logic are also examined. Emphasizes moral philosophy, including ethical relativism, utilitarianism, and Kantian ethics.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring

HU 2701 - Logic and Critical Thinking

Introduction to everyday reasoning and formal logic. Important goal is to develop skills of argument identification, analysis, and evaluation. Students learn how to symbolize ordinary language statements and arguments and to determine their validity or invalidity using proof and truth-table methods.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

HU 2702 - Ethical Theory and Moral Problems

An introduction to the major concepts and theories of normative ethics and metaethics and an examination of a variety of issues in applied ethics including poverty and economic justice, lying and truth-telling, euthanasia, sexual conduct, and issues in communication ethics.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Summer

HU 2810 - Research and Writing in Communication

Prepare students to evaluate, design, and conduct research in communication. Develops research-related writing strategies and proficiency.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Pre-Requisite(s): UN 1015(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

HU 2830 - Public Speaking & Multimedia

Introduces the fundamentals of public speaking and multimedia applications. Emphasis on speaking/listening competencies in face-to-face and digital environments using online and digital tools.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring

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

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

HU 3015 - Advanced Composition

Advanced instruction in composing substantive arguments based on primary and secondary research. Multidisciplinary inquiry-based projects ask students to write for both academic and lay audiences in print and digital forms. Specific research methods, writing technologies, and topics vary by section.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3120 - Technical and Professional Communication

A study of written and oral communication in technical and scientific environments; emphasizes audience, writing processes, genres of scientific and technical discourse, visual communication, collaboration, professional responsibility, clear and correct expression. Students write and revise several documents and give oral report(s). Computer Intensive.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring, Summer

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3130 - Rhetoric of Science and Technology

A study of contemporary theories of rhetoric and their application to interpreting and critiquing various forms of persuasive discourse, especially in science and technology.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3150 - Topics in Literacy Studies

A study of how and why different groups of people use reading and writing differently in varying situations and in varying textual media. Topics may include the various ways texts function and reading is used; the authority of written texts; access to reading and writing and to various textual media.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3151 - The Rhetoric of Everyday Texts

The examination and production of everyday texts such as social media, image-texts, web pages, signs, museum exhibits, architecture, and fashion in terms of their theoretical, historical, cultural, and technological contexts. Student should expect to produce "everyday texts" of their own as well as write about texts examined in the course.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3201 - Level II-A Chinese Language and Culture

Review and continued study of listening, speaking, reading, and writing in Chinese. Students learn how to communicate in Chinese societies. Includes study of various aspects of the Chinese culture.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Pre-Requisite(s): HU 2202 or Language Placement Chinese >= 201

HU 3202 - Level II-B Chinese Language and Culture

Further study of Chinese language. Includes study of vocabulary, idioms, and sentences structure to improve conversational, reading, and writing abilities. Includes discussion of various aspects of Chinese culture.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Pre-Requisite(s): HU 3201 or Language Placement Chinese >= 301

HU 3204 - Level III Topics in Chinese Literature and Culture

Study of various genres of Chinese literature and of various aspects of Chinese society, emphasizing, historical and cultural backgrounds. Conducted primarily in Chinese.

Credits: 3.0; Repeatable to a Max of 6

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Pre-Requisite(s): HU 3202 or Language Placement Chinese >= 401

HU 3241 - Level II A Less Commonly Taught Language and Culture

Review and continued study of listening, speaking, reading, and writing in less commonly taught language. Students learn how to communicate in target culture. Includes study of various aspects of the culture in which the language is used.

Credits: variable to 5.0

Semesters Offered: On Demand

Pre-Requisite(s): HU 2242

HU 3242 - Level II B Less Commonly Taught Language and Culture

Further study of less commonly taught language. Includes study of vocabulary, idioms, and sentence structure to improve conversational reading and writing abilities and discussions of various aspects of culture in which the language is used.

Credits: variable to 5.0

Semesters Offered: On Demand

Pre-Requisite(s): HU 3241

HU 3253 - World Literatures & Cultures

Comparative approach to world literatures and cultures. May include literary works, critical essays, films, music, and other representations of world culture.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 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 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3262 - Topics in Francophone Cultures

An introduction to Francophone cultures (in English) in a comparative perspective. Includes a survey of French history and its influence on Francophone societies. Includes study of film and other media and a critical examination of cross-cultural differences between French, Francophone, and U.S. cultures.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): UN 1015 and (UN 1025)

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: Fall, Spring

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3264 - Topics in Spanish-Speaking Cultures

An introduction to Spanish-speaking cultures (in English) in comparative historical perspectives. Includes a survey and a critical cross-cultural examination of Latin-American cultures and Spanish-speaking societies (European, Caribbean, and North, Central and South American) through literature, music, film, art, and other media.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3265 - Topics in East Asian Cultures

Introduction to the contemporary and traditional cultures of China, Korea, and Japan taught through readings, films, lectures, and discussions. Taught in English.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

HU 3271 - Level II-A French Language and Culture

Review and continued study of grammar, vocabulary, speaking, listening, reading, and writing in French. Includes written compositions and oral presentations. Cultural focus on several Francophone regions of the world.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring

Pre-Requisite(s): HU 2272 or HU 2273 or Language Placement French >= 331

HU 3272 - Level II-B French Language and Culture

Continued study of grammar, vocabulary, speaking, listening, reading, and writing in French. Includes written compositions, oral presentations, and reading of brief literary texts. Cultural focus on several Francophone regions of the world.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring

Pre-Requisite(s): HU 3271 or Language Placement French >= 421

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 Lang Placement French I-A Tran >= 301

HU 3274 - Level III Topics in French Literature and Culture

Topics in French literature and its historical and cultural contexts. May include selections from Francophone literature. Conducted in French.

Credits: 3.0; Repeatable to a Max of 6

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring - Offered alternate years beginning with the 2013-2014 academic year

Pre-Requisite(s): HU 3272 or HU 3273 or Language Placement French >= 501

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: Fall - Offered alternate years beginning with the 2013-2014 academic year

Pre-Requisite(s): HU 3272 or HU 3273 or Language Placement French >= 501

HU 3280 - Level I-C German Language and Culture

Concluding study of the basics of the German language acquainting students with the essentials of oral and written German, with emphasis on conversational skills. Includes continued discussion of cultures and societies of contemporary German-speaking Europe.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring

Pre-Requisite(s): HU 2282 or Language Placement German >= 221

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 3280 or Language Placement German >= 301

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 >= 371

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 3282 or Language Placement German >= 451

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 3282 or Language Placement German >= 521 or CEEB German Language >= 3

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 3282 or Language Placement German >= 521 or CEEB German Language >= 3

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 >= 321

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 2232 or HU 3291 or Language Placement Spanish >= 401

HU 3293 - Level IIC Spanish Composition and Conversation

Advanced grammar, composition, and conversation practice. Readings may include texts from literary, social, economic, scientific, engineering, or business discourses in the context of Hispanic cultures. Students completing this course may apply for placement credit.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring

Pre-Requisite(s): HU 2293 or HU 3291 or HU 3292 or Language Placement Spanish >= 480

HU 3294 - Hispanic Literatures and Cultures

Study of selected works of literature, culture, and civilization from selected regions of the Spanish-speaking world. May incorporate study of literary genres and historical periods as related to Spain and/or Latin American cultures.

Students completing this course may apply for placement credits.

Credits: 3.0; Repeatable to a Max of 9

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring

Pre-Requisite(s): HU 3293 or Language Placement Spanish >= 631

HU 3295 - Level III Advanced Spanish for Literacies

Spanish for Special Purposes is designed for students who anticipate careers in which they will need to interact with Hispanic communities in the U.S. or abroad and who wish to continue study of Spanish language and culture for specific professional purposes. Topics include Spanish for engineering and other sciences, healthcare, business, and legal professions.

Credits: 3.0; Repeatable to a Max of 9

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2015-2016 academic year

Pre-Requisite(s): HU 3293 or Language Placement Spanish >= 631

HU 3296 - Introduction to Hispanic Literatures and Cultures

Overview of Iberian and/or Latin American literatures and cultures from colonial through contemporary periods, including the arts and popular movements, from a multidisciplinary perspective. Course is repeatable up to six credits.

Credits: 3.0; Repeatable to a Max of 6

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand - Offered alternate years beginning with the 2015-2016 academic year

Pre-Requisite(s): HU 3293 or Language Placement Spanish >= 631

HU 3326 - Topics in World Cinema

This course focuses on mainstream and/or independent films in their historical and sociocultural contexts from selected regions such as Latin America, Africa, the Middle East, Asia, and Europe.

Credits: 3.0; Repeatable to a Max of 6

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2017-2018 academic year

Pre-Requisite(s): HU 2324 and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3327 - Film Style and Genre

Focus on film style and genre with an emphasis on study of directors, movements, and aesthetics and their technological, theoretical, and socio-cultural contexts. Includes small lab projects.

Credits: 3.0

Lec-Rec-Lab: (0-2-3)

Semesters Offered: Spring, Summer - Offered alternate years beginning with the 2018-2019 academic year

Pre-Requisite(s): HU 2324 and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

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

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3401 - Gender and Culture

Interrelations of gender and culture, including comparative analysis of constructions of gender. May examine different societies and/or different historical periods.

Credits: 3.0; Repeatable to a Max of 6

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3410 - Introduction to Diversity Studies in the United States

This course provides students with a better understanding of underrepresented populations within the United States by examining the social, cultural, and personal consequences of gender, race, ethnicity, class, sexual orientation, (dis)ability, and other significant identities.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2015-2016 academic year

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3502 - Mythology

Survey of the major mythological systems of the world with particular attention to those areas of commonality among various civilizations. Films may provide contextual background.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2001-2002 academic year

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3504 - Studies in the Novel

Examination of the novel in world literature with special attention to the historical, cultural, and personal contexts within which the author is writing. Film versions may be examined.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3505 - Literary Forms, Genres, and Modes

This course examines one or more literary forms, genres, and modes such as tragedy, satire, romance, science fiction, fantasy, comedy, epics, novels, short stories, poetry, and/or creative nonfiction.

Credits: 3.0; Repeatable to a Max of 6

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3506 - Major Authors

An intensive study of the life and works of one or more significant literary figures.

This course will also focus on the social and historical contexts that shaped the author's reputation and standing in the literary, theatrical, or cinematic canon.

Credits: 3.0; Repeatable to a Max of 6

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3507 - Cultural Traditions in Literature

An advanced study of a specific transnational or trans-Atlantic historical period or aesthetic movement that illustrates the development of literary and/or cinematic traditions. Courses will include relevant theory and criticism.

Credits: 3.0; Repeatable to a Max of 6

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3508 - Literature and the Environment

In this course students examine the interdisciplinary relationship between literature and environmental and ecological studies. Topics to be explored include eco-criticism, eco-feminism, environmental (in) justice, indigeneity, sustainability, and animal studies.

Credits: 3.0; Repeatable to a Max of 6

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2017-2018 academic year

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3513 - Shakespeare

In-depth study of a limited number of Shakespearean plays with special attention to dramatic structure, character development, theme presentation, and theatre history. Includes extensive study of Renaissance influences, possibly film versions of selected plays, and examination of current critical theories.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3514 - Workshop in Creative Nonfiction

Advanced work in creative nonfiction writing; workshop format. Readings will include short memoirs, personal essays, lyric essays, and other sub-genres of contemporary creative nonfiction. Emphasis on individual production through process-oriented writing exercises, small group workshops, individual conferences, and revision/development.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Pre-Requisite(s): HU 2510 and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3515 - Workshop in Poetry

Advanced work in poetry writing; workshop format. Students will study contemporary and emerging works in order to enrich and stimulate their own poetic practice. Emphasis on individual production through process-oriented writing exercises, small group workshops, individual conferences, and revision/development.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Pre-Requisite(s): HU 2510 and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3516 - Workshop in Fiction

Advanced work in fiction writing; workshop format. Readings will include 'canonical', contemporary, and emerging examples of short-form fiction. Emphasis on individual production through process-oriented writing exercises, small group workshops, individual conferences, and revision/development.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Pre-Requisite(s): HU 2510 and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

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

Pre-Requisite(s): UN 1015 and (UN 1025)

HU 3545 - Literature Across Borders

Study of literary genres, themes, and movements, with emphasis on comparing and contrasting perspectives reflected in literatures from Western and non-Western cultures. Topics may focus on historical, social, aesthetic, and cultural factors as they influence these literatures. Films may be used.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2004-2005 academic year

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3554 - Science Fiction and Fantasy Literature

Close study of significant works in science fiction and fantasy. Examines genre features and usage and attends to a writer's style and methods. Regularly focuses on historical fiction and fantasy using film to help establish literary context.

Credits: 3.0; Repeatable to a Max of 6

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3557 - Literature and Science

Focuses on depictions of science in literature and literary features of scientific texts from a range of historical periods, genres, and nationalities. May include the influence of scientific methods on literature and vice versa (for instance, narrative medicine).

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand - Offered alternate years beginning with the 2015-2016 academic year

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3600 - Professional Development in the Humanities

Addresses conventions and expectations for professional development through projects such as portfolio development and research into contemporary professional and work place issues. Explores career and graduate school opportunities.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Major(s): Comm and Culture Studies, Scientific & Tech Comm (BS), Liberal Arts, Scientific & Tech Comm (BA), Humanities, English; May not be enrolled in one of the following Class(es): Freshman

HU 3605 - Grammar and Usage in Society

Description and analysis of current standards of grammar and usage in the U.S. Students acquire an understanding of the structures of American English as well as an understanding of the social forces underlying standardization and the processes of language change.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Restrictions: May not be enrolled in one of the following Class(es): Freshman

HU 3606 - Editing

Examination of the responsibilities of an editor and grounding in basic editorial skills. Topics include situations of editing, levels of editing, readability, correctness, style, relations with authors, and social and political implications of editing.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

HU 3621 - Introduction to Journalism

Introduction to the history and practice of journalism. Includes critical analysis of journalistic coverage, journalistic style and editing, and ethical issues in journalism.

Credits: 3.0

Lec-Rec-Lab: (0-2-3)

Semesters Offered: Fall

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3630 - Publications and Information Management

Principles of information selection, editing, layout, and graphics essential to the scheduling, budgeting, and production of various print and digital publications.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Pre-Requisite(s): HU 2642 and HU 2633 or HU 2645

HU 3693 - Science Writing

Introduces writing, research, and editing that contribute to a public understanding of science. Possible topics: health, environment, medicine, public policy.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2016-2017 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3694 - Grant Writing

Introduces fundamentals of grant proposal writing and research. Possible topics: writing for nonprofits, grant writing in various disciplines, researching funding resources.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2016-2017 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman
Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3695 - Digital Writing and Rhetoric

Social, ethical, and historical implications of digital writing and rhetoric, investigating digital contexts, with special attention to analyzing and producing digital content.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2016-2017 academic year

Pre-Requisite(s): HU 2642 or HU 2130 or HU 3120

HU 3700 - Philosophy of Science

Examination of problems involved in scientific methodology such as theory structure, concept formation, scientific explanation, hypothetico-deductive model, role of experimentation, function of paradigms and analogies, distinction between science and pseudoscience, extent to which science is value-free or value-laden, social responsibility of scientists, and aims of science.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3701 - Philosophy of Technology

A study of philosophical analyses of technology. Topics may include: the essence and nature of technology, technology and human existence; the notion that we live in a technological age; and ethical issues surrounding the use, abuse, and ubiquity of technology.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3702 - Philosophy of Religion

An examination of some philosophical questions in diverse religious traditions including the existence of God, the problem of evil, and the nature of religious experience.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3710 - Engineering Ethics

A study of ethical questions confronting individual engineers and the engineering profession. Among the issues to be explored are the meaning of professionalism, the social responsibilities of engineers, engineer-employer and engineer-client relationships, whistle-blowing, conflicts of interest, and competitive bidding.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3711 - Biomedical Ethics

A study of several important ethical and philosophical issues that arise in medical practice and in biomedical science. Issues may include euthanasia, abortion, the physician-patient relationship, experimentation involving human subjects, and allocation of scarce biomedical resources. General ethical theories and concepts are used to shed light on those issues.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3800 - Media and Society

Examines contemporary forms of mediated communication. Emphasis on understanding media economics and impacts of media on attitudes, values, behavior, and identity. Topics may include propaganda, advertising, political communication, journalism, media violence, social media, surveillance, and media policy.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3810 - Technology and Culture

Considers interrelationships between technology and culture. Includes understanding the context within which technologies are developed and used, and how assumptions about technology shape knowledge, practice, and creative action. Issues such as progress, determinism, ethics, gender, race, class, globalization, and "humanness".

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3820 - Interpersonal Communication

Examines practices and issues of relational communication and encourages critical awareness of common assumptions. Topics include verbal and nonverbal cues, conflict models, friendship, intimacy, and the interpersonal significance of race, gender, class, and disability.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3830 - Creativity, Culture, and Change

Examines the sources of creativity and the ways that it has been used to change cultural values, feelings, beliefs, and practices. A project-based course that cultivates and applies creative action toward cultural change.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2016-2017 academic year

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3832 - Advanced Digital Presentation

Students will use digital delivery modes to design and deliver presentations for a variety of social and professional purposes. Students will explore the ethical, social, and political implications of digital delivery for civic life and public discourse.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3840 - Organizational Communication

An approach to understanding organizations in their socio-historical contexts from a variety of theoretical perspectives in communication. Explores meanings, roles, relations, interactions, and structures from a communication perspective.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3850 - Cultural Studies

Examines the way that culture communicates values, feelings, beliefs; structures differential relations of power and possibility; creates difference and hierarchy. Considers the struggles over meaning that open up possibilities for diversity and change.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2015-2016 academic year

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3860 - Popular Culture

Introduces fundamentals of cultural theory and media criticism. Considers historical, social, political, and economic contexts of popular culture from a media studies perspective.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3871 - New Media Theory

Examines relationships among changing communication technologies and communication theories. Emphasizes issues involving emerging technologies and emerging theory.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3872 - Color, Visuality, and Culture

Engages with color as an aesthetic, theoretical, historical, cultural, and political concept. Explores what color is made of, how color shapes meaning, and how color functions in various expressive and interpretative contexts including politics, science, and industry.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2017-2018 academic year

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3882 - Media Industries

Examines economic, political, and cultural aspects of media industries (cinema, broadcasting, music, gaming, telecommunications, and advertising) from historical and contemporary contexts.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3890 - Documentary

Considers technical, theoretical, aesthetic and ethical dimensions of documentary media through analysis and production.

Credits: 3.0

Lec-Rec-Lab: (0-2-3)

Semesters Offered: Fall

HU 3910 - Language and Globalization

Considers the historical rise of the English language and other dominant languages, and present effects on minority and endangered languages within the US and abroad; World Englishes and dialectal variation; and the interaction of forces of globalization/standardization with localization/identity.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2009-2010 academic year

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3940 - Language and Identity

Examines how individuals create and perform their social identities through and in response to language, considering social variables such as race, ethnicity, class, gender, sexuality, disability, geography, power, ideology, etc. Explores how these variables may intersect, clash, and be resolved.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2010-2011 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 3961 - 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 4101 - Multiliteracies Center Practicum

Reflective practicum in which theories of learning, literacy, and cultural differences are applied in the Multiliteracies Center setting under the supervision of a writing center professional.

Credits: 1.0; May be repeated

Lec-Rec-Lab: (0-1-0)

Semesters Offered: Fall, Spring

Restrictions: Permission of instructor required

Pre-Requisite(s): UN 1015

HU 4130 - Special Topics in Rhetoric and Composition

An in-depth examination of particular issues, theories, methodologies, or concepts in the field of rhetoric and composition, such as comparative rhetorics, computers and writing, multi-lingual writing, feminist rhetorics, and multi-modal composition.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2000-2001 academic year

HU 4140 - Methods of Teaching English

Application of learning theories and national and state professional standards to the teaching of English. Emphasizes methods, materials, and media used to teach adolescents. Requires admission to teacher education program or permission of instructor. Includes significant time in the field.

Credits: 4.0

Lec-Rec-Lab: (0-3-3)

Semesters Offered: Fall

Restrictions: Permission of department required

Pre-Requisite(s): ED 4110 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: Spring

Pre-Requisite(s): ED 4110 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) and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

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) and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

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

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 4327 - Visual Storytelling and Cinema

Production-intensive focus on how filmmakers use narrative design, cinematography, and editing to tell a story, realize a creative vision, and engage an audience.

Credits: 3.0

Lec-Rec-Lab: (0-2-3)

Semesters Offered: Spring

Pre-Requisite(s): HU 2324

HU 4500 - Senior Seminar in English

A course especially designed for English majors. In depth exploration of various topics with special emphasis on theory and production. Students will be required to engage relevant secondary sources and theory in a longer, final seminar paper.

Credits: 3.0; Repeatable to a Max of 6

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

HU 4501 - BA Thesis

Students will be required to engage relevant secondary sources and theory in a longer, final seminar paper or creative project. Produce a cultural final project that demonstrates advanced critical and creative analysis. Proposals must be approved in the prior semester.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior

HU 4600 - Humanities Internship

Provides internship experience directly related to student's course of study. Students conduct work at internship site in addition to academic assignments that encourage them to connect their professional and academic experience. Requires approval of department internship coordinator.

Credits: variable to 6.0; May be repeated

Semesters Offered: On Demand

Restrictions: Permission of department required

HU 4625 - Risk Communication

Examines models for communicating risks associated with environmental, safety, and health hazards. Considers the diverse roles assumed by the public under each of these models and means of ensuring that risks are communicated fairly, honestly, and accurately.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 4626 - International Technical Communication

Focuses on international workplace communication. Introduces theories of globalization. Topics may include localization, contrastive rhetoric, technical translation, and international usability.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2018-2019 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): HU 2600

HU 4628 - Usability Evaluation and User Experience Design

Theories and practices of usability evaluation and user experience design relevant to technical communication contexts. Individual and team projects with emphasis on the development of instructions and procedures.

Credits: 3.0

Lec-Rec-Lab: (0-2-1)

Semesters Offered: Spring

Pre-Requisite(s): HU 3120 and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 4634 - Advanced Practicum in Scientific and Technical Communication

Provides technical communication majors with opportunities to design and produce various communication products expected in their working careers, such as sets of procedures, proposals, progress reports, sets of directions, and style sheets. The course will also require students to complete, with advice from the instructor, one major client-involved project such as a brochure, newsletter, web site, technical training module, etc.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Major(s): Scientific & Tech Comm (BS), Scientific & Tech Comm (BA)

Pre-Requisite(s): HU 3120 and HU 2600

HU 4642 - Advanced Topics in Media

Critical and/or applied topics in advanced media, theory and development. Topics may include game design, mobile media, color, photography, film, or graphic design.

Credits: 3.0; Repeatable to a Max of 6

Lec-Rec-Lab: (0-2-3)

Semesters Offered: On Demand

Restrictions: Permission of instructor required

HU 4690 - Special Topics in Technical and Professional Communication

In-depth examination of selected topics in scientific and technical communication, or on professional and workplace writing in selected genres such as reports, proposals, or whitepapers.

Credits: 3.0; Repeatable to a Max of 9

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: May not be enrolled in one of the following Class(es): Freshman

HU 4700 - Topics in Philosophy

The topics will ordinarily be in-depth examinations of a particular philosopher or philosophical problem, tradition, or historical period. Examples include the philosophy of Kant, the existence of God, American pragmatism, death and dying, and ancient Greek philosophy.

Credits: 3.0; Repeatable to a Max of 9

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Pre-Requisite(s): UN 1015

HU 4701 - Political Philosophy

Issues in political philosophy, such as the moral foundations of political systems, the proper relation between the individual and the state, and the justification of social institutions. Philosophers studied may include Plato, Aristotle, Machiavelli, Hobbes, Locke, Marx, de Tocqueville, Mill, Dewey, and Rawls.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 4710 - Sports Medicine and Ethics

Examines ethical issues in sports medicine. Topics include the ethical responsibilities and conflicts of interest for team physicians, research on athletes, sport-related concussions, and doping. Philosophical ethical foundations, and professional ethical codes for sports medicine will be studied.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand

Restrictions: May not be enrolled in one of the following Class(es): Freshman

HU 4711 - Biomedical Research Ethics

Examination of bioethical issues in biomedical research. Topics include research on human subjects, on vulnerable populations, and animals, principles of ethical research, and societal expectations for researchers.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2018-2019 academic year

Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior

Pre-Requisite(s): HU 3711

HU 4725 - Existentialism and Phenomenology

Introduction to the philosophical traditions of existentialism and phenomenology. Topics might include: the nature of human existence and of freedom; the importance of world, self, anxiety, death, and authenticity; and the foundations of knowledge, experience and meaning.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2013-2014 academic year

Pre-Requisite(s): UN 1015 and (UN 1025)

HU 4800 - Media and Globalization

Examines the development of modern international communication systems, the rise of transnational media industries and technologies, and debates about their global impacts.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2014-2015 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 4850 - Surveillance, Media, and Film

Considers surveillance practices and the surveillance imaginary through films that take surveillance as their principal feature. Covers perspectives such as those of the watchers and the watched; kinds and purposes of surveillance; and the relationship between filmic surveillance and our sense and practices of freedom versus control.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2018-2019 academic year

Pre-Requisite(s): UN 1015 or (UN 1025)

HU 4890 - Topics in Communication

In-depth examination of selected issues or problems in the study of communication, such as gender and communication, the environment and communication, sound and communication, violence and communication.

Credits: 3.0; Repeatable to a Max of 9

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

HU 4961 - Practicum in TESOL

Observation, case studies, tutoring, instructional assistance, and supervised teaching experience in English to speakers of other languages.

Credits: variable to 6.0; Repeatable to a Max of 6

Semesters Offered: On Demand

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

Pre-Requisite(s): HU 3962

Kinesiology & Integrative Physiology**KIP 1000 - Introduction to Exercise Science**

Introduction to the fields and career opportunities in the exercise sciences.

Credits: 1.0

Lec-Rec-Lab: (1-0-0)

Semesters Offered: Fall

KIP 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

KIP 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

KIP 1900 - Student Athlete 101

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

KIP 2000 - Professionalism in Kinesiology

This course will assist students in gaining skills for entering into career-focused roles with professional competency, learning to apply these skills through shadowing experiences, and preparing to transition from a college student to a professional in kinesiology.

Credits: 2.0

Lec-Rec-Lab: (1-1-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Major(s): Sports and Fitness Management, Exercise Science; May not be enrolled in one of the following Class(es): Freshman

KIP 2100 - 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

KIP 2200 - Health Promotion

This course emphasizes methods in planning, designing, implementing, and improving health/wellness promotion programs. Client motivation, behavior change, and physical activity for special populations will be addressed.

Credits: 2.0

Lec-Rec-Lab: (2-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2018-2019 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): EH 1500 or KIP 1500

KIP 2300 - Sports and Fitness Leadership

Course is designed to help students succeed in leadership principles, effective communication, team work, and introspection. Students will lead, teach, and collaborate with their peers through different assignments and active participation in class.

Credits: 2.0

Lec-Rec-Lab: (2-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2015-2016 academic year

KIP 2400 - Principles of Sports Officiating

Theory and practice of officiating various sports common in the community and school setting.

Credits: 2.0

Lec-Rec-Lab: (1-0-2)

Semesters Offered: Fall - Offered alternate years beginning with the 2014-2015 academic year

KIP 2500 - Athletic Training Practicum

An experiential learning course in which students assist certified athletic trainers in preventive and post-injury care of collegiate athletes. Topics include professionalism, acute injury prevention techniques, and post-injury management and care.

Credits: 1.0

Lec-Rec-Lab: (0-0-1)

Semesters Offered: Fall, Spring

Pre-Requisite(s): KIP 2100 or EH 3050

KIP 2600 - Introduction to Public Health

An overview of public health including the history of public health and major issues facing the U.S. and global populations. Topics include societal conditions that lead to health disparities, role of government, and the basic sciences supporting public health.

Credits: 2.0

Lec-Rec-Lab: (2-0-0)

Semesters Offered: Fall

KIP 2610 - 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

Restrictions: Permission of instructor required

Pre-Requisite(s): PE 2028

KIP 2800 - Special Topics in Kinesiology

Examination of current topics in the field of kinesiology. Literature and research topics are addressed.

Credits: variable to 9.0; Repeatable to a Max of 9

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Major(s): Sports and Fitness Management, Exercise Science

KIP 3000 - 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

KIP 3100 - Exercise Assessment and Prescription

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: Fall

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

Pre-Requisite(s): BL 2020 and BL 2021

KIP 3200 - 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 2020 and BL 2021 and (EH 3100 or KIP 3100)

KIP 3300 - 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

KIP 3310 - Methods of Coaching

Students will demonstrate knowledge of skills, tactics, strategies, and sporting principles in coaching sport teams.

Credits: 2.0

Lec-Rec-Lab: (1-1-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2013-2014 academic year

KIP 3400 - 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: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2018-2019 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman

KIP 3410 - Facilities & Events Management

Students will learn about managing sports facilities including risk management, administration of personnel, organization, and administrative efficiency.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2015-2016 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman

KIP 3500 - Sports Medicine Practicum

This course allows students to experience current topics in sports medicine along with learning up-to-date orthopedic injury assessment, treatment, and rehabilitation.

Credits: variable to 2.0; Repeatable to a Max of 2

Semesters Offered: Fall, Spring

Pre-Requisite(s): KIP 2500

KIP 3600 - 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 or KIP 1500) and BL 2020

KIP 3700 - Lifetime Fitness

To gain a thorough understanding in all areas of personal fitness through functional anatomy, exercise physiology, health and physical fitness, screening and evaluation, nutrition, weight management, exercise prescription and programming considerations, training instruction, and consideration for special populations.

Credits: 3.0

Lec-Rec-Lab: (2-0-2)

Semesters Offered: Summer

KIP 4000 - 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

KIP 4100 - 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: Spring

Co-Requisite(s): KIP 4110

Pre-Requisite(s): BL 2020 and BL 2021

KIP 4110 - 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: Spring

Co-Requisite(s): KIP 4100

KIP 4120 - Molecular Exercise Physiology

Introduces cellular and molecular mechanisms by which exercise causes adaption. Topics include how gene variations affect human performance, signal transduction pathways involved in regulation of metabolism, and mechanism of exercise in prevention and treatment of chronic diseases.

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 2100 and (EH 4210 or KIP 4100)

KIP 4200 - Biomechanics of Human Movement

An in-depth view of the biomechanical properties of the musculoskeletal system. The course provides detailed analyses of the kinetics of human movement, material properties of the component tissues, and dynamic processes of adaptation to stress and strain of the system.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

Co-Requisite(s): KIP 4210

Pre-Requisite(s): BL 2020 and (EH 1500 or KIP 1500) and PH 1110 and PH 1111

KIP 4210 - Biomechanics of Human Movement Laboratory

A companion course to EH4500. Hands-on experience, including data collection, analysis, and interpretation using various equipment in biomechanics.

Credits: 1.0

Lec-Rec-Lab: (0-0-3)

Semesters Offered: Fall

Co-Requisite(s): KIP 4200

Pre-Requisite(s): BL 2020 and (EH 1500 or KIP 1500) and PH 1110 and PH 1111

KIP 4300 - Motor Learning and Control

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 or KIP 1500) and BL 2020

KIP 4400 - Strength and Conditioning

Theory and practice in development and administration of comprehensive strength and conditioning programs for both the athlete and individual of any level. Includes knowledge, safety concerns and skill techniques necessary for teaching and administering at any strength and conditioning facility.

Credits: 3.0

Lec-Rec-Lab: (2-1-0)

Semesters Offered: Fall

Pre-Requisite(s): BL 2020 and BL 2021

KIP 4500 - Athletic Training Capstone

Experiential learning that engages the student with mentorship and assisting certified athletic trainers.

Credits: 1.0

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring

Pre-Requisite(s): KIP 3500 or EH 3060

KIP 4600 - Sports and Fitness Promotions

Development and implementation of marketing plans for sports and fitness businesses. Topics include marketing of sporting events and fitness programs, use of traditional media for promotion, web-based advertising (new media), and business branding.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2011-2012 academic year

Pre-Requisite(s): MKT 3000

KIP 4610 - 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: 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

KIP 4620 - Sports Media

This course examines the impact sports and the media have on each other and the sports consumer. Students will gain a greater understanding of the operation of sports media and communications at all levels of sports (amateur, collegiate, professional) and the role of sports media in American society.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2018-2019 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): MKT 3000

KIP 4630 - Financial Aspects of Sports

The course is designed to provide the student with an understanding of the basic concepts that underlie financial management, and an ability to apply these concepts to the analysis of financial issues within the sport industry.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2019-2020 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): ACC 2000

KIP 4690 - 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 KIP 3000) and (EH 3020 or KIP 3300)

KIP 4700 - EKG Interpretation

Course is designed for students who are going to pursue future career related to cardiac rehabilitation, physical therapy and students in the Pre-Med program. Students will learn cardiac electrophysiology, the pathophysiology, the diagnosis, and treatment of cardiac arrhythmias, and related cardiovascular diseases. Class will build bridge between basic sciences and human health.

Credits: 2.0

Lec-Rec-Lab: (0-2-0)

Semesters Offered: Spring

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

Pre-Requisite(s): BL 2020 and BL 2021

KIP 4710 - Sports Medicine and Ethics

Examines ethical issues in sports medicine. Topics might include the ethical responsibilities and conflicts of interest for team physicians, research on athletes, sport-related concussions, and doping. Philosophical ethical foundations, and professional ethical codes for sports medicine will be studied.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand

Restrictions: May not be enrolled in one of the following Class(es): Freshman

KIP 4720 - Exercise Pharmacology

Course will bridge between basic sciences and human health. The course focuses on understanding the fundamental concept of exercise pharmacology and pharmacological treatment of diseases of various systems including cardiovascular, respiratory, endocrine, neuronal, hormonal, and renal systems.

Credits: 2.0

Lec-Rec-Lab: (2-0-0)

Semesters Offered: Spring

Pre-Requisite(s): BL 2020 and BL 2021

KIP 4730 - Physical Therapy Seminar

Seminar for students who are interested in physical therapy profession. Course will include self-directed learning and group work. Topics may include evidence based medicine, literature review writing and evaluation, healthcare reimbursement, clinical decision making, health screenings, and other current topics.

Credits: 1.0

Lec-Rec-Lab: (0-1-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2017-2018 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

Pre-Requisite(s): BL 2020 and BL 2021

KIP 4740 - Epidemiology

An introduction to the principles and methods of epidemiology to understand the distribution and determinants of health in a population. Topics include basic epidemiological statistics, study design, and sources/impact of bias and error.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring

KIP 4800 - Special Topics in Kinesiology

Examination of current topics in the field of exercise science. Literature and research topics are addressed.

Credits: variable to 9.0; Repeatable to a Max of 9

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of department required; Must be enrolled in one of the following Major(s): Sports and Fitness Management, Exercise Science; May not be enrolled in one of the following Class(es): Freshman, Sophomore

KIP 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 42 hours for each credit earned.

Credits: variable to 9.0; Repeatable to a Max of 9

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of department required; Must be enrolled in one of the following Major(s): Exercise Science; May not be enrolled in one of the following Class(es): Freshman, Sophomore

Pre-Requisite(s): KIP 2000 or EH 2850

KIP 4910 - 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 42 hours for each credit earned.

Credits: variable to 12.0; Repeatable to a Max of 12

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of department required; Must be enrolled in one of the following Major(s): Sports and Fitness Management; May not be enrolled in one of the following Class(es): Freshman, Sophomore

Pre-Requisite(s): KIP 2000 or EH 2850

KIP 4950 - Research in Kinesiology

A literature and laboratory research experience in kinesiology that culminates in a written report or oral presentation of the work performed.

Credits: variable to 3.0; Repeatable to a Max of 9

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of department required

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 1020 - Quantitative Literacy

Stresses the role of contemporary mathematical thinking and the connection between mathematics and our daily lives. Topics include the mathematics of the Census, planning and scheduling, coding theory, game theory, symmetry and patterns, logic and modeling, and political flavor topics.

Credits: 4.0

Lec-Rec-Lab: (0-4-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Major(s): Anthropology, Communication, Culture & Media, Comm and Culture Studies, Theatre & Electr. Media Perf., English, Theatre & Entertain Tech (BS), Theatre & Entertain Tech (BA), Liberal Arts, Psychology, Sports and Fitness Management, History, Social Sciences, Liberal Arts with History Opt, Scientific & Tech Comm (BA), Scientific & Tech Comm (BS), Humanities

Pre-Requisite(s): ALEKS Math Placement \geq 00

MA 1030 - College Algebra I

This course is the first of a two semester sequence. It examines the behavior of linear, polynomial, and rational functions. In addition, algebraic methods commonly needed in calculus are reviewed.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring

Co-Requisite(s): MA 0030

Pre-Requisite(s): ALEKS Math Placement \geq 00

MA 1031 - College Algebra II with Trigonometry

This course is the second of a two semester sequence. It examines the behavior of exponential, logarithmic, and trigonometric functions. Also, algebraic and trigonometric methods commonly needed in calculus are reviewed. MA1030 and MA1031 together are equivalent to MA1032.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring

Co-Requisite(s): MA 0031

Pre-Requisite(s): MA 1030

MA 1032 - Precalculus

This course examines the behavior of linear, polynomial, rational, exponential, logarithmic and trigonometric functions.

Credits: 4.0

Lec-Rec-Lab: (0-4-0)

Semesters Offered: Fall, Spring, Summer

Pre-Requisite(s): ALEKS Math Placement \geq 56

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 ALEKS Math Placement \geq 70 or

CEEB Calculus AB \geq 2 or CEEB Calculus BC \geq 2 or CEEB Calculus AB

Subscore \geq 2

MA 1160 - Calculus with Technology I

An introduction to single-variable calculus, which includes a computer laboratory. Topics include trigonometric, exponential, and logarithmic functions,

differentiation and its uses, and basic integration. Integrates symbolic tools, graphical concepts, data and numerical calculations.

Credits: 4.0

Lec-Rec-Lab: (0-3-1)

Semesters Offered: Fall

Pre-Requisite(s): MA 1032 or MA 1031 or ALEKS Math Placement \geq 80 or

CEEB Calculus AB \geq 3 or CEEB Calculus BC \geq 3 or CEEB Calculus AB

Subscore \geq 3

MA 1161 - Calculus Plus w/ Technology I

An introduction to single-variable calculus, which includes a computer laboratory. Topics include trigonometric, exponential, logarithmic functions, differentiation and its uses, and basic integration. Integrates symbolic tools, data and numerics, and graphical concepts and is similar to MA1160, going at a different pace.

Credits: 5.0

Lec-Rec-Lab: (0-4-1)

Semesters Offered: Fall, Spring, Summer

Pre-Requisite(s): MA 1032 or MA 1031 or ALEKS Math Placement \geq 70 or CEEB Calculus AB \geq 2 or CEEB Calculus BC \geq 2 or CEEB Calculus AB Subscore \geq 2

MA 1600 - Introduction to Scientific Simulation

Introduction to simulation, a powerful computational tool for many scientific problems. Case studies and projects will be drawn from various fields. Prior programming experience is not required; all necessary computational skills will be developed in the course.

Credits: 3.0

Lec-Rec-Lab: (0-2-2)

Semesters Offered: Spring

Pre-Requisite(s): MA 1160 or MA 1161

MA 1910 - Exploring Symmetry Groups

Mathematical discovery and invention in group theory: transformations, finite figures, strip patterns, wall patterns, finite groups, and Cayley diagrams. Develops the ability to find and describe patterns, to generalize from observations, to formulate conjectures, and to support conjectures with analysis and, when possible, formal proof.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2016-2017 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 2017-2018 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 2015-2016 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 2018-2019 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 2160 - Calculus with Technology II

Continued study of calculus, which includes a computer laboratory. Topics include integration and its uses, function approximation, vectors, and elementary modeling with differential equations.

Credits: 4.0

Lec-Rec-Lab: (0-3-1)

Semesters Offered: Fall, Spring, Summer

Pre-Requisite(s): MA 1160 or MA 1161 or MA 1135 or CEEB Calculus AB \geq 3 or CEEB Calculus BC \geq 3 or CEEB Calculus AB Subscore \geq 3

MA 2320 - Elementary Linear Algebra

An introduction to linear algebra and how it can be used. Topics include systems of equations, vectors, matrices, orthogonality, subspaces, and the eigenvalue problem. Not open to students with credit in MA2321 or MA2330.

Credits: 2.0

Lec-Rec-Lab: (0-2-0)

Semesters Offered: Fall, Spring, Summer

Restrictions: May not be enrolled in one of the following Major(s): Mathematics, Software Engineering, Computer Science

Pre-Requisite(s): MA 1160 or MA 1161 or MA 1135

MA 2321 - Elementary Linear Algebra

Offered first half of semester, to be taken concurrently with MA3521. The course is an introduction to linear algebra and how it can be used. Topics include systems of equations, vectors, matrices, orthogonality, subspaces and the eigenvalue problem. Not open to students with credit in MA2320 or MA2330.

Credits: 2.0

Lec-Rec-Lab: (0-4-0)

Semesters Offered: Fall, Spring

Restrictions: May not be enrolled in one of the following Major(s): Mathematics, Software Engineering, Computer Science

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.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring

Pre-Requisite(s): MA 1160 or MA 1161 or MA 1135

MA 2600 - Scientific Computing

Use of mathematical modeling and computer simulation to solve scientific problems. Includes introduction to elementary numerical methods (numerical integration, solution of linear systems, solution of nonlinear equations, optimization) and to computer programming. Requires programming project(s).

Credits: 3.0

Lec-Rec-Lab: (0-2-2)

Semesters Offered: Fall

Pre-Requisite(s): MA 2160 and (MA 2320 or MA 2321 or MA 2330)

MA 2710 - Introduction to Statistical Analysis

Introduction to statistical reasoning and methods. Topics include uses and abuses of statistics, graphical and descriptive methods, correlation and regression, probability and statistical inference. The course will include a written project and an introduction to statistical software. Not open to students with credit in MA2720 or MA3710 or MA3715.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Major(s): Statistics, Mathematics

Pre-Requisite(s): MA 1160 or MA 1161 or MA 1135

MA 2720 - Statistical Methods

Introduction to the design and analysis of statistical studies. Topics include methods of data collection, descriptive and graphical methods, probability, statistical inference on means, regression and correlation, and single variable ANOVA. Not open to students with credit in MA2710, MA3710, or MA3715.

Credits: 4.0

Lec-Rec-Lab: (0-4-0)

Semesters Offered: Fall, Spring, Summer

Restrictions: May not be enrolled in one of the following Major(s): Mathematics

Pre-Requisite(s): MA 1020 or MA 1030 or ALEKS Math Placement \geq 50 or CEEB Calculus BC \geq 2 or CEEB Calculus AB Subscore \geq 2

MA 2910 - Mathematical Experimentation

Mathematical discovery and invention in topics such as algebra, analysis, applied mathematics, discrete mathematics, geometry, and statistics. Class projects require students to find and describe patterns, generalize from observations, formulate and support conjectures with analysis and, when possible, proof. Projects require written reports describing the student's findings, conjectures, and conclusions.

Credits: 3.0

Lec-Rec-Lab: (0-2-2)

Semesters Offered: Spring

Pre-Requisite(s): MA 1160 or MA 1161

MA 2990 - Elementary Topics in Mathematics

Students study a particular area in mathematics ordinarily not covered in 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: (0-3-1)

Semesters Offered: Fall, Spring, Summer

Pre-Requisite(s): MA 2160 or CEEB Calculus BC \geq 3

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 MA2710, MA2720, or MA3715.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring, Summer

Pre-Requisite(s): MA 2160

MA 3715 - Biostatistics

Introduction to the design and analysis of statistical studies in the health and life sciences. Topics include study design, descriptive and graphical methods, probability, inference on means, categorical data analysis, and linear regression. Not open to students with credit in MA2710, MA2720, or MA3710.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Pre-Requisite(s): MA 1135 or MA 1160 or MA 1161

MA 3720 - Probability

Introduction to probabilistic methods. Topics include probability laws, counting rules, discrete and continuous random variables, expectation, joint distributions, and limit theorems.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Summer

Pre-Requisite(s): MA 1160 or MA 1161

MA 3740 - Statistical Programming and Analysis

Project-based course enabling students to identify statistical methods and analysis using R and S. Topics include exploratory data analysis, classical statistical tests, sample size and power considerations, correlation, regression, and design experiments using advanced programming techniques.

Credits: 3.0

Lec-Rec-Lab: (0-2-2)

Semesters Offered: Fall, Spring

Pre-Requisite(s): MA 2710 or MA 2720 or MA 3710 or MA 3715

MA 3750 - Introduction to SAS Programming

This course is a workshop focused on solving problems for SAS certified base/certified programmers for SAS credentials.

Credits: 1.0; Graded Pass/Fail Only

Lec-Rec-Lab: (0-1-0)

Semesters Offered: Spring

Pre-Requisite(s): MA 2710 or MA 2720 or MA 3710 or MA 3715

MA 3810 - Introduction to Actuarial Mathematics

Nominal and effective rates of interest, present value, discount, annuities certain, sinking funds, bonds, yield rates, and amortization schedules. Financial calculator skills for professional exams. Immunization, swaps, interest rate policy. May include other topics on the FM exam.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

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 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 36

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 - Numerical Methods for PDEs

Derivation, analysis, and implementation of numerical methods for partial differential equations; applications to fluid mechanics, elasticity, heat conduction, acoustics, or electromagnetism.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Pre-Requisite(s): (MA 3520 or MA 3521 or MA 3530 or MA 3560) and MA 3160

MA 4710 - Regression Analysis

Covers simple, multiple, and polynomial regression; estimation, testing, and prediction; weighted least squares, matrix approach, dummy variables, multicollinearity, model diagnostics and variable selection. A statistical computing package is an integral part of the course.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Pre-Requisite(s): MA 2710 or MA 2720 or MA 3710 or MA 3715

MA 4720 - Design and Analysis of Experiments

Covers construction and analysis of completely randomized, randomized block, incomplete block, Latin squares, factorial, fractional factorial, nested and split-plot designs. Also examines fixed, random and mixed effects models and multiple comparisons and contrasts. The SAS statistical package is an integral part of the course.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Pre-Requisite(s): MA 2710 or MA 2720 or MA 3710 or MA 3715

MA 4730 - Nonparametric Statistics

Introduces nonparametric techniques that require less restrictive assumptions on the data. Topics include statistical inference concerning location and dispersion parameters as well as the general distributions. Goodness-of-fit tests for count and ordinal data are also discussed.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2019-2020 academic year

Pre-Requisite(s): MA 2710 or MA 2720 or MA 3710

MA 4760 - Mathematical Statistics I

Covers joint probability distributions, functions of random variables, sampling and limiting distributions, introduction to parameter estimation.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Pre-Requisite(s): MA 3720

MA 4770 - Mathematical Statistics II

Continuation of MA4760. Theory of point and interval estimation; properties of estimators, theory of hypothesis testing, analysis of variance, analysis of categorical data and other topics as time allows

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Pre-Requisite(s): MA 4760

MA 4780 - Time Series Analysis and Forecasting

Statistical modeling and inference for analyzing experimental data that have been observed at different points in time. Topics include models for stationary and nonstationary time series, model specification, parametric estimation, and time regression models.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Pre-Requisite(s): (MA 2710 or MA 2720 or MA 3710 or MA 3715) and MA 3720

MA 4790 - Predictive Modeling

Application, construction, and evaluation of statistical models used for prediction and classification. Topics include data visualization and exploratory methods, the normal theory regression model, logistic and Poisson regression, linear and quadratic discriminant analysis, and classification with logit models.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Pre-Requisite(s): MA 3740 or MA 4710 or MA 4720 or MA 4780

MA 4810 - Financial Markets and Actuarial Math

Derivative Securities, hedging, arbitrage, binomial and Black-Scholes pricing models. Long-term insurance coverages, life insurance and annuities. May include other topics on professional SOA 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 and MA 3810

MA 4820 - Loss Distributions and Actuarial Math

Loss distribution used for modeling insurance claims. Frequency, severity, coverage modifications, risk measures, models, credibility, short term insurance coverages. 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: Fall

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

Pre-Requisite(s): ED 4700(C)

MA 4908 - Theory of Numbers with Technology

Mathematical induction, Euclid's algorithm, prime and composite integers, algebra of congruences, Chinese remainder theorem, quadratic reciprocity law, number theoretic functions, first degree Diophantine equations, Pythagorean triples, Fermat and Mersenne numbers, factoring algorithms, tests for primality and various applications. Projects use Mathematica and EXCEL software packages.

Credits: 3.0

Lec-Rec-Lab: (0-2-2)

Semesters Offered: Spring

Pre-Requisite(s): MA 3210 or MA 3310 or MA 3924

MA 4945 - History of Mathematics

Survey of the development of mathematics from ancient times to today. How cultural, mathematical, and technological developments have influenced one another throughout history. Course provides all necessary historical background.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

MA 4990 - Topics in Mathematics

Students study in greater depth a particular area of mathematics not studied in existing courses.

Credits: variable to 4.0; Repeatable to a Max of 6

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required

Mechanical Engineering – Engineering Mechanics**MEEM 2110 - Statics**

Force systems in two and three dimensions. Includes composition and resolution of forces and force systems, principles of equilibrium applied to various bodies, simple structures, friction, centroids, and moments of inertia. Vector algebra used where appropriate. Prerequisite of MA2160 with a grade of C or better is required.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following College(s): Sch of Forest Res & Envir Sci, College of Engineering

Pre-Requisite(s): MA 2160

MEEM 2150 - Mechanics of Materials

Introduction to mechanical behavior of materials, including stress/strain at a point, principle stresses and strains, stress-strain relationships, determination of stresses and deformations in situations involving axial loading, torsional loading of circular cross sections, and flexural loading of straight members. Also covers stresses due to combined loading and buckling of columns.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following College(s): Sch of Forest Res & Envir Sci, College of Engineering

Pre-Requisite(s): MEEM 2110

MEEM 2201 - Introductory Thermodynamics

This course introduces concepts of energy, energy conversion, mechanisms of heat and work transfer in processes and in cycles. It also covers the first and the second laws of thermodynamics.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following College(s): College of Engineering

Pre-Requisite(s): MA 2160 and CH 1150 and CH 1151

MEEM 2700 - Dynamics

First course in the principles of dynamics, covering the motion of a particle, the kinematics and kinetics of plane motion of rigid bodies, the principles of work and energy, impulse and momentum. Uses vector methods.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring, Summer

Pre-Requisite(s): PH 2100 and (MEEM 2110 or ENG 2120) and MA 3160(C)

MEEM 2901 - Mechanical Engineering Practice I

Students develop laboratory and computer skills. Topics include product dissection, data acquisition, materials testing, 2D finite element modeling, 1D modeling and simulation.

Credits: 2.0

Lec-Rec-Lab: (0-1-3)

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Major(s): Mechanical Engineering

Pre-Requisite(s): MEEM 2110(C) and ENG 1102 and UN 1015

MEEM 2911 - Mechanical Engineering Practice II

Students further develop laboratory and simulation skills as they model and validate dynamic mechanical and thermal/fluid systems. They also fabricate system components using a variety of manufacturing methods.

Credits: 3.0

Lec-Rec-Lab: (0-2-3)

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Major(s): Mechanical Engineering

Pre-Requisite(s): MEEM 2901 and MEEM 2201(C) and (MA 2320(C) or MA 2321(C) or MA 2330(C))

MEEM 3201 - Introductory Fluid Mechanics & Heat Transfer

Course emphasizes internal flow and modes of heat transfer: control volume analysis of mass, momentum and energy, pipe and duct flow, dimensional analysis, steady and unsteady heat conduction, internal convection and application of boundary conditions, and simple heat exchanger design.

Credits: 4.0

Lec-Rec-Lab: (0-4-0)

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Major(s): Mechanical Engineering

Pre-Requisite(s): MEEM 2201 and MEEM 2911 and (MA 3520 or MA 3521 or MA 3530 or MA 3560)

MEEM 3400 - Mechanical System Design and Analysis

In this course, students learn mechanical synthesis and analysis methods. They use case studies to develop relationships between design and performance. They apply synthesis methods to the design of a new product.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Major(s): Mechanical Engineering

Pre-Requisite(s): MEEM 2150 and MEEM 2700

MEEM 3600 - Introduction to Manufacturing

This course introduces manufacturing processes, including deformation, subtractive, additive, and molding processes. Students learn how things are made in both low and high production environments. It includes design for manufacturing considerations.

Credits: 3.0

Lec-Rec-Lab: (0-2-2)

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following College(s): School of Technology, College of Engineering

Pre-Requisite(s): MEEM 2150 and (MY 2100 or MSE 2100)

MEEM 3750 - Dynamic Systems

This course deals with the modeling, analysis and control of mixed physics systems. It covers differential equation generation for mechanical, thermal, and electrical systems, their simulation, and methods for analyzing their performance operating in both open and closed loop.

Credits: 4.0

Lec-Rec-Lab: (0-4-0)

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Major(s): Mechanical Engineering

Pre-Requisite(s): MEEM 2700 and MEEM 2911 and (MA 3520 or MA 3521 or MA 3530 or MA 3560)

MEEM 3901 - Mechanical Engineering Practice III - Model Based Design

Students apply the engineering design process by combining engineering science with simulation tools to guide design decisions. They use energy-based models to determine design direction and design-based simulation to select and optimize components and subsystems to meet design requirements.

Credits: 2.0

Lec-Rec-Lab: (0-1-2)

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Major(s): Mechanical Engineering

Pre-Requisite(s): MEEM 2911(C) and MEEM 2150 and MEEM 2700

MEEM 3911 - Mechanical Engineering Practice IV

Students further develop their skills to identify and solve ill-defined problems. They tackle a complex system problem by gathering evidence, proposing a solution, and iterating to optimize the solution.

Credits: 3.0

Lec-Rec-Lab: (0-2-3)

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Major(s): Mechanical Engineering

Pre-Requisite(s): MEEM 3901 and EE 3010 and MEEM 3400(C) and MEEM 3600(C)

MEEM 3999 - Mechanical Engineering Undergraduate Research Project

An undergraduate research experience during the junior year in mechanical engineering. Students work directly with faculty on active research projects/grants. A report will be submitted and graded.

Credits: 3.0; Repeatable to a Max of 6

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of department required; Must be enrolled in one of the following Major(s): Mechanical 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.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

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 or MEEM 3400

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.

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 fundamentals of energy conversion and storage. Topics include fossil and nuclear fuels, thermodynamic power cycles, solar energy, photovoltaics, and energy storage.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Restrictions: May not be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): MEEM 4201(C) or MEEM 3230(C) or CM 3230 or ENG 3200 or MY 3100 or MSE 3100

MEEM 4201 - Intermediate Thermodynamics

A study of the principles of thermodynamics, including fundamental concepts and introduction of the analytical treatments of the first and second laws. Topics include exergy, ideal and real gas mixtures, gas and vapor power cycles, psychrometry, combustion, and chemical equilibrium.

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, Mechanical Eng-Eng Mechanics, Engineering Mechanics

Pre-Requisite(s): MEEM 3201(C)

MEEM 4202 - Intermediate Fluid Mechanics and Heat Transfer

Intermediate fluid mechanics and heat transfer topics are covered. These include necessary considerations of: differential analysis of fluid flows based on Navier-Stokes equations, lift and drag, convective heat transfer in external flows, radiation, and simple considerations of condensation and boiling.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Major(s): Mechanical Engineering, Mechanical Eng-Eng Mechanics, Engineering Mechanics

Pre-Requisite(s): MEEM 3201

MEEM 4210 - Computational Fluids Engineering

Introduces computational methods used to solve fluid mechanics, and thermal transfer problems. Discusses theoretical and practical aspects. Modern computer-based tools are used to reinforce principles and introduce advanced topics in fluid mechanics, and thermal transport.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Restrictions: May not be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): MEEM 3201(C)

MEEM 4220 - Internal Combustion Engines I

This course teaches the operational principles of spark-ignition and compression-ignition internal combustion engines through the application of thermodynamics, fluid dynamics, and heat transfer. Course studies engine performance, efficiency, and emissions using cycle-based analysis, combustion thermochemistry, and compressible fluid flow.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Restrictions: May not be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): MEEM 4201(C)

MEEM 4230 - Compressible Flow/Gas Dynamics

Fundamentals of one-dimensional gas dynamics, including flow in nozzles and diffusers, normal shocks, frictional flows, and flows with heat transfer or energy release; introduction to oblique shocks.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Pre-Requisite(s): MEEM 3201

MEEM 4235 - Wind Energy

Student will be introduced to the underlying principles of wind energy conversion, including wind turbine design, aerodynamics, construction, control, and operation. The evaluation of concurrent aspects such as wind resource turbine siting, grid integration, and environmental, and social impact will be covered.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Pre-Requisite(s): MEEM 3201

MEEM 4240 - Combustion & Air Pollution

Introduces sources of emissions from combustion, applies thermo-chemical principles to model the formation of pollutants, and identifies impacts of air pollutants on the environment and human health. Addresses pollution regulation and societal impacts including emissions, climate change, and air quality.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following College(s): College of Engineering; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

Pre-Requisite(s): MEEM 2200 or MEEM 2201

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 3201

MEEM 4260 - Fuel Cell Technology

Fuel cell basics, operation principles and performance analysis. Emphasis on component materials and transport phenomena on proton exchange membrane fuel cells along with other types of fuel cells. Hydrogen production, transportation, and storage. Balance of plant and systems analysis.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following College(s): College of Engineering; Must be enrolled in one of the following Class(es): Senior

Pre-Requisite(s): MEEM 3201 or CM 3110

MEEM 4295 - Introduction to Propulsion Systems for Hybrid Electric Vehicles

Hybrid electric vehicle analysis will be developed and applied to examine the operation, integration, and design of powertrain components. Model based simulation and design is applied to determine vehicle performance measures in comparison to vehicle technical specifications. Power flows, losses, energy usage, and drive quality are examined over drive-cycles via application of these tools.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Summer

Restrictions: Must be enrolled in one of the following College(s): College of Engineering; May not be enrolled in one of the following Class(es): Freshman, Sophomore

Pre-Requisite(s): MEEM 2200 or ENG 3200 or MEEM 2201

MEEM 4296 - Experimental Studies in Hybrid Electric Vehicles

Hands-on course examines hybrid electric vehicles from an energy perspective. Topics include powertrain architecture, vehicle testing, fuel consumption, aerodynamics and rolling resistance, engines, batteries, electric machines and power electronics. Course culminates with study of system interactions with emphasis on idle reduction and regenerative braking.

Credits: 3.0

Lec-Rec-Lab: (0-2-2)

Semesters Offered: Fall, Summer

Restrictions: Must be enrolled in one of the following College(s): College of Engineering; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

MEEM 4404 - Mechanism Synthesis/Dynamic Modeling

Students apply kinematic synthesis techniques in design and analysis of mechanical systems. They develop synthesis software to link to dynamic analysis packages such as ADAMS, I-DEAS, Unigraphics, etc. They investigate influences of process variation on system output and learn methods to minimize the variation influences.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring

Pre-Requisite(s): MEEM 3502(C) or MEEM 3400

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 3400 and (MA 2320 or MA 2321 or MA 2330) and (MA 3520 or MA 3521 or MA 3530 or MA 3560)

MEEM 4430 - Advanced Computer Aided Design and Manufacturing Methods

Students apply advanced solid modeling techniques to construct solid models of mechanical systems, document the design using GD&T conventions as per ASME standards, simulate the motion of the system, and learn the computer aided manufacturing and additive manufacturing techniques.

Credits: 4.0

Lec-Rec-Lab: (0-3-2)

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Major(s): Mechanical Engineering, Mechanical Eng-Eng Mechanics, Engineering Mechanics; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

Pre-Requisite(s): ENG 1102 and MEEM 3600

MEEM 4450 - Vehicle Dynamics

This course will develop the models and techniques needed to predict the performance of a road vehicle during drive off, braking, ride, and steering maneuvers. Topics to be covered include: acceleration and braking performance, power train architecture, vehicle handling, suspension modeling, tire models, and steering control. Matlab, Adams Car, and Amesim, will be used as computational tools.

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; Must be enrolled in one of the following Class(es): Junior, Senior

Pre-Requisite(s): MEEM 3400 or EE 3261

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 or MEEM 3600

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)) or MEEM 3600(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.

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: Fall, Spring

Pre-Requisite(s): (MY 2100 or MSE 2100) and MEEM 2150 and (MEEM 3201(C) or CM 3110)

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 3400(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.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior

Pre-Requisite(s): MA 3710 or MA 3720 or MA 2710 or MA 2720

MEEM 4655 - Production Planning

Provides 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) or MEEM 3400(C)

MEEM 4675 - Design of Material Handling Systems

Material handling deals with the handling operations and stock of material inside a warehouse. Emphasis is given to design, static and dynamic analysis and component sizing of lifts, cranes, continuous handling equipment (conveyors) and forklifts.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following College(s): College of Engineering, School of Business & Economics; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

Pre-Requisite(s): MEEM 2150

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 4695 - Additive Manufacturing

Background, principles, process chain, software aspects, post-processing, open-source tools, applications, and future directions of AM technologies are discussed.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Major(s): Mechanical Engineering; Must be enrolled in one of the following Class(es): Senior

Pre-Requisite(s): MEEM 3600

MEEM 4701 - Analytical and Experimental 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 3750

MEEM 4702 - Shock and Vibration

Theory and experimental techniques in vibration control, Shock, structural health monitoring, condition based maintenance, dynamic measurements, test methods, and planning.

Credits: 3.0

Lec-Rec-Lab: (0-2-2)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Major(s): Mechanical Engineering, Mechanical Eng-Eng Mechanics, Engineering Mechanics

Pre-Requisite(s): (MEEM 3911 and MEEM 3750) or MEEM 4775

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 3750

MEEM 4707 - Autonomous Systems

The main concepts of autonomous systems will be introduced including motion control, navigation, and intelligent path planning and perception. This is a hands-on project based course. Students will have the opportunity to work with mobile robotics platforms.

Credits: 3.0

Lec-Rec-Lab: (0-2-2)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Major(s): Mechanical Engineering, Mechanical Eng-Eng Mechanics, Engineering Mechanics

Pre-Requisite(s): MEEM 3750 or MEEM 4700

MEEM 4720 - Space Mechanics

This course presents the vector-based solution of the two-body problem and the solution for Kepler's equations. The course will also cover basic orbit determination techniques, impulsive orbit transfer maneuvers, interplanetary trajectories, ground tracks, and rendezvous problems.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring

Restrictions: May not be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): MEEM 2700

MEEM 4730 - Dynamic System Simulation

Methods for simulating dynamic systems described by ordinary differential equations using numerical integration are developed. Quantifying simulation errors for both batch and real-time, control system applications is covered along with numerical optimization strategies for model validation. MATLAB and Simulink are used to illustrate key concepts.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Pre-Requisite(s): MEEM 3750

MEEM 4775 - Analysis & Design of Feedback Control Systems

This course covers topics of control systems design. Course includes a review for modeling of dynamical systems, stability, and root locus design. Also covers control systems design in the frequency domain, fundamentals of digital control and nonlinear systems.

Credits: 4.0

Lec-Rec-Lab: (0-3-2)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Major(s): Mechanical Engineering, Mechanical Eng-Eng Mechanics, Engineering Mechanics

Pre-Requisite(s): MEEM 3750

MEEM 4810 - Introduction to Aerospace Engineering

Introductory course on topics relevant to aerospace engineering and science. Topics include history, properties of the atmosphere, the solar system, atmospheric and space vehicles, mission design, and vehicle design and performance.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Pre-Requisite(s): (MEEM 2150 or ENG 2120) and (MEEM 3201 or ENG 3200)

MEEM 4820 - Introduction to Aerospace Propulsion

Principles of jet propulsion, cycle analysis and component analysis (non-rotating components, compressors, turbines). Principles of rocket propulsion, chemical rockets, propellants, turbomachinery, electrical propulsion. Review of thermodynamics for fluid flow, one-dimensional gas dynamics, and boundary layer theory included.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Pre-Requisite(s): MEEM 4230(C)

MEEM 4850 - Naval Systems and Platforms

Concepts of semi- and fully-autonomous naval and marine sensors and sensing platforms demonstrated through classroom learning and hands-on experiences. Laboratories will focus on operating sensors and sensor packages, in oceanographic and other applications.

Credits: 3.0

Lec-Rec-Lab: (0-2-2)

Semesters Offered: Fall

Pre-Requisite(s): MEEM 3201 or ENG 3200 or MY 3110 or MSE 3110

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 and MEEM 3900) or (MEEM 3201(C) and MEEM 3750(C) and MEEM 3911 and MA 3710)

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 and MEEM 3000(C) and MEEM 3502(C) and MEEM 3900) or (MEEM 3201 and MEEM 3750 and 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

Mechanical Engineering Technology**MET 1020 - Technology Computer Applications**

Introductory course intended to develop knowledge of computer modeling techniques such as solid modeling, spreadsheet, word processing, presentation, and project time line software utilized throughout the technology curriculum.

Credits: 3.0

Lec-Rec-Lab: (0-2-2)

Semesters Offered: Fall

MET 1540 - Materials Science

Introduction to the fundamentals of materials. Introduces mechanical properties, phase diagrams, thermal processing, alloying, and corrosion. Examines material selection with regard to design considerations.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Pre-Requisite(s): CH 1000 or (CH 1150 and CH 1151)

MET 2120 - Statics and Strength of Materials

Statics includes the study of forces, analysis of simple structures, equilibrium, moment of inertia, and friction. Materials considers stress and strain under axial, torsional, and bending loads. Laboratory exercises include materials testing and problem solving.

Credits: 4.0

Lec-Rec-Lab: (0-3-2)

Semesters Offered: Fall

Pre-Requisite(s): (MA 1160(C) or MA 1161(C)) and (PH 1140 or PH 1110)

MET 2130 - Dynamics

Particle and rigid plane body kinematics and kinetics covers inertia force, work-energy-power and impulse-momentum methods. Emphasizes development of student skills in problem definition and problem solving.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Pre-Requisite(s): MET 2120 or ENG 2120

MET 2153 - Machine Tool Fundamentals and Applications

A study of basic machining processes: including setup and operation of lathes, milling machines, drill presses, grinders and saws. Students are exposed to fundamental machining processes, nomenclature and machine operation with an overall focus on safety and quality control.

Credits: 2.0

Lec-Rec-Lab: (0-1-3)

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Major(s): Mechanical Engineering Tech

MET 2400 - Practical Applications in Parametric Modeling

Intermediate course intended to expand the student's knowledge of computer modeling techniques, introducing advanced assemblies and GD&T concepts. Investigates advanced concepts available to the designer.

Credits: 3.0

Lec-Rec-Lab: (0-2-2)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Major(s): Mechanical Engineering Tech

Pre-Requisite(s): MET 1020 or TE 1020

MET 3242 - Machine Design I

An introduction to mechanical design for technology students. The coursework applies principles of statics, dynamics and mechanics of materials to the design of simple mechanical components and systems.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Pre-Requisite(s): MA 2160 and MET 2130

MET 3400 - Applied Fluid Mechanics

This course provides an introduction to the principles of fluid mechanics and their application to natural and engineering problems. Students are expected to have a good understanding of statics and dynamics. Development of engineering problem-solving skills will be emphasized.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Pre-Requisite(s): MET 2130

MET 3451 - Machine Design II

This course extends the study of mechanical design begun in MET3242, Machine Design I and looks at more complex components and systems. Design projects are given special emphasis.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Pre-Requisite(s): MET 3242

MET 3500 - Manufacturing Processes

Focuses on practical aspects of design and manufacturing. Covers fundamentals of manufacturing processes and includes a weekly lab to provide hands-on experience with manufacturing issues that influence component design.

Credits: 4.0

Lec-Rec-Lab: (0-3-2)

Semesters Offered: Fall

Pre-Requisite(s): (MET 1020 or ENG 1102) and (MET 1540 or MY 2100 or MSE 2100)

MET 3700 - Applied Thermodynamics

Engineering thermodynamics principles including work, heat and temperature, pure substances, closed and open systems, first and second laws of thermodynamics, and power and refrigeration cycles.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior

Pre-Requisite(s): MET 3250 or MET 3400

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) or MA 3710(C)

MET 4300 - Applied Heat Transfer

Heat transfer principles including conduction, convection and radiation heat transfer mechanisms. Practical applications include thermal insulation, heat sink and heat exchanger design.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior

Pre-Requisite(s): MET 3600 or (MET 3700 and MET 4360(C)) or MEEM 2200 or MEEM 2201

MET 4350 - Principles and Application of Heating, Ventilating, and Air Conditioning Systems

This course is designed to provide an introduction to heating, ventilating, and air conditioning systems that combines design principles with real-world applications. Students will conduct heating and cooling load calculations, learn psychrometrics, and have the opportunity to work on a realistic design project.

Credits: 3.0

Lec-Rec-Lab: (0-2-1)

Semesters Offered: Spring

Pre-Requisite(s): MET 4300

MET 4355 - Industrial Systems Simulation

Creating simulation models of various industrial systems in order to analyze and experiment with characteristics of real life systems for the purpose of engineering process improvement and production design.

Credits: 3.0

Lec-Rec-Lab: (0-2-2)

Semesters Offered: Spring

MET 4360 - Thermal-Fluids Laboratory

This course provides hands-on experience with selected thermal-fluid laboratory experiments. Site/plant visits will be included for exposure to some of the practical aspects of the thermal-fluids area.

Credits: 1.0

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall

Pre-Requisite(s): MET 3400 and MET 3700 and MET 4300(C)

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 or (MET 3400 and MET 4360(C))

MET 4390 - Internal Combustion Engines

An introduction to the basic principles and applications of internal combustion engines. The course covers design, development and testing of engine components and systems. A laboratory exposes students to current industry methods.

Credits: 3.0

Lec-Rec-Lab: (0-2-2)

Semesters Offered: Fall

Pre-Requisite(s): MET 3600 or MET 4300 or (MET 3700 and MET 4360(C))

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: 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): Junior, Senior

Pre-Requisite(s): MET 3451(C)

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. Not open to students with credit in MEEM4655 or OSM3000.

Credits: 3.0

Lec-Rec-Lab: (0-2-2)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior

MET 4550 - Computer Aided Manufacturing

Course is designed to apply techniques used in parametric modeling (CAD) and convert this information to all phases of production planning, machining, scheduling and quality control.

Credits: 3.0

Lec-Rec-Lab: (0-2-2)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior

Pre-Requisite(s): MET 2153 and MET 2400

MET 4575 - Senior Project I

Research and beginning design projects using computer-aided engineering methods, physical models, and/or prototypes. Evaluation and design optimization methods for efficient and cost-effective designs.

Credits: 2.0

Lec-Rec-Lab: (0-0-4)

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 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 3242(C)

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 4675 - Senior Project II

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.

Credits: 2.0

Lec-Rec-Lab: (0-0-4)

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 4575

MET 4780 - Advanced Manufacturing

An introduction to advanced manufacturing processes, both traditional and nontraditional. Study of both theory and practice will be tied to laboratory experiments utilizing a spectrum of unique materials and methods.

Credits: 3.0

Lec-Rec-Lab: (0-2-2)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior

Pre-Requisite(s): MEEM 2500 or MET 3500

MET 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 certification exam.

Credits: 1.0; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-3)

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Class(es): Senior

Management

MGT 2000 - Team Dynamics and Decision Making

Develops individual and group problem-solving skills using active, hands-on learning. Emphasizes problem identification and problem solution under conditions of ambiguity and uncertainty. Stresses creativity, interpersonal skills and skill assessment, communication, group process and teamwork, and action planning.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring

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

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

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: Spring - Offered alternate years beginning with the 2016-2017 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

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

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

MGT 4000 - Strategic Management

A capstone course focusing on managing from a strategic perspective for gaining advantages in competitive and dynamic environments, emphasizing understanding of industry, business models, growth strategies, and managing business portfolios. Integrates knowledge from finance, marketing, and organizational behavior.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following College(s): School of Business & Economics; Must be enrolled in one of the following Class(es): Senior

Pre-Requisite(s): MIS 2000 and FIN 3000 and OSM 3000 and MGT 3000 and MKT 3000 and BUS 2300

MGT 4100 - International Management

Addresses the complexities and challenges faced by companies operating in an increasingly globalized world. Focuses on political, legal, ethical, cultural, economic issues, and on the entry, growth and knowledge management strategies of developed and developing country firms.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

Pre-Requisite(s): MGT 3000 and EC 3100(C)

MGT 4200 - Entrepreneurial Management

Draws upon the fundamental concepts of entrepreneurship covered in MGT3800 (Entrepreneurship) and enhances the understanding of these concepts from a strategic and entrepreneurial management point of view.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Pre-Requisite(s): MGT 3800

MGT 4500 - Managing Change in Organizations

Studies organizational theory with an emphasis on managing change in organizations. Examines forces for change in the external environment, methods for managing change (design and implementation), the impact of change on people, and leaders as agents of change. Case studies and student projects prepare the student to manage change in organizations.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

Pre-Requisite(s): MGT 3000

MGT 4600 - Management of Technology and Innovation

Introduces disruptive innovation concepts and provides occasions for their application to timely and relevant cases. Provides an understanding of technology management and innovation processes as they occur inside and outside of organizations.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

MGT 4700 - Human Resource Management

Examines methods that organizations use to meet organizational goals through influencing worker attitudes, behaviors, and performance. Topics include recruitment, selection, training, performance appraisal, and compensation.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

Pre-Requisite(s): MGT 3000

MGT 4990 - Special Topics in Management

Examines additional management topics and issues in greater depth. A single offering of this course will concentrate on one or two topics which vary.

Credits: variable to 3.0; Repeatable to a Max of 6

Semesters Offered: On Demand

Restrictions: Permission of instructor required

Pre-Requisite(s): MGT 3000

Management Information Systems

MIS 2000 - IS/IT Management

Focuses on the theory and application of the information-systems discipline within an organizational context, and identifies the roles of management, users, and information systems professionals. Covers the use of information systems and implications for decision support to improve business processes, and addresses the ethical, legal, and social issues of IT.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring, Summer

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): BUS 1100 or CS 1121 or CS 1131 or ENG 1101 or (ENG 1001 and ENG 1100) or SAT 1200

MIS 2100 - Introduction to Business Programming

Develops business problem solving skills through the application of a commonly used high-level business programming language. Topics include the nature of the business programming environment, fundamentals of the language (e.g., programming constructs, data management, manipulation of simple data structures), structured programming concepts, desirable programming practices and design, debugging and testing techniques.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring

MIS 2200 - Web Programming

Covers technologies, tools, and environments related to the development of web-enabled business solutions. Topics include the development environment for web-based solutions, key development technologies, desirable development practices, and design, programming, debugging and testing methods.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): MIS 2100 or CS 1121 or CS 1131

MIS 3000 - Business Process Analysis

Studies business decision management discipline using business rules, process models (e.g. flowcharts, unified modeling language, swim lanes), and information systems to improve efficiency and effectiveness. Emphasis on industry standards and business process management used to increase productivity.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2018-2019 academic year

Pre-Requisite(s): MIS 2000

MIS 3100 - Business Database Management

Emphasizes database principles that are constant across different database software products through concrete examples using a relational database management system. Provides a well-rounded business perspective about developing, utilizing, and managing organizational databases.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Pre-Requisite(s): MIS 2000(C)

MIS 3200 - Systems Analysis and Design

Provides an understanding of the IS development and modification process and the evaluation choices of a system development methodology. Emphasizes effective communication with users and team members and others associated with the development and maintenance of the information system. Stresses analysis and logical design of departmental-level information system.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Pre-Requisite(s): MIS 2000(C)

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 2018-2019 academic year

Pre-Requisite(s): MIS 2000 and (MIS 3100 or CS 3425)

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: Spring - Offered alternate years beginning with the 2017-2018 academic year

Pre-Requisite(s): MIS 2000

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 - Offered alternate years beginning with the 2018-2019 academic year

Restrictions: Must be enrolled in one of the following Class(es): Senior

Pre-Requisite(s): MIS 3100 and MIS 3200

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: Spring

Restrictions: Must be enrolled in one of the following Class(es): Senior

Pre-Requisite(s): MIS 2100 and MIS 3100 and MIS 3200

MIS 4200 - Management of Cyber Security

Review of information systems security concepts and industry best practices. Subject matter is organized to provide students a foundation to sit for the Certified Systems Security Professional (CISSP) exam after completion.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2017-2018 academic year

Pre-Requisite(s): MIS 2000 or CS 1111 or CS 1121 or CS 1131

MIS 4990 - Special Topics in Management Information Systems

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: variable to 3.0; Repeatable to a Max of 6

Semesters Offered: On Demand

Pre-Requisite(s): MIS 2000

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

MKT 3200 - Consumer Behavior

Introduces students to the general concepts, processes, and variables pertinent to consumers' decision making and lifestyle choices. Discussions will be based on a variety of disciplines: psychology, sociology, economics, and anthropology.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

Pre-Requisite(s): MKT 3000

MKT 3400 - Integrated Marketing Communications

Discusses how a variety of marketing communication methods, such as advertising, public relations, sales promotion, point-of-purchase, and direct marketing are developed, implemented, and evaluated in an integrative manner.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Pre-Requisite(s): BA 3800 or MKT 3000

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) and MKT 3000

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 - Offered alternate years beginning with the 2018-2019 academic year

Pre-Requisite(s): 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: Fall - Offered alternate years beginning with the 2019-2020 academic year

Pre-Requisite(s): MKT 3000

MKT 4300 - Global Marketing

Discusses the critical elements of international marketing strategy: socio-political-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

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

MKT 4700 - Marketing Strategy

Discusses various aspects of creative and value-enhancing marketing strategies. Topics include branding, new product development, market research, marketing communication, services, consumer culture, corporate social responsibility, social media marketing, and globalization.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall, Spring

Restrictions: May not be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): MKT 3200 and MKT 3600 and MKT 4300(C)

MKT 4990 - Special Topics in Marketing

Examines current issues in marketing. Topics are selected based on the interest to faculty and students

Credits: variable to 3.0; Repeatable to a Max of 6

Semesters Offered: On Demand

Restrictions: Permission of instructor required

Pre-Requisite(s): MKT 3000

MSE 3130 - Materials Characterization II

Fundamentals and application of instrumental analysis in characterization of bulk materials and powders, and their internal phases and external surfaces. Demonstrates spectroscopic and surface analysis techniques in identification of ceramics and polymers and their phases. Discusses the limitations and capabilities of elemental, chemical and structural characterization methods combined with statistical analysis of data.

Credits: 4.0

Lec-Rec-Lab: (2-1-3)

Semesters Offered: Fall

Pre-Requisite(s): MY 2100 or MSE 2100

MSE 3140 - 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 to provide a bridge between phase transformation theory and industrial/laboratory practice.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring

Pre-Requisite(s): (MY 2110 or MSE 2110) and (MY 3100 or MSE 3100) and (MY 3200(C) or MSE 3120(C))

MSE 3150 - Introduction to Semiconductor Materials & Devices

An introduction to 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 devices function in electrical circuits depends on material selection and processing.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

Pre-Requisite(s): PH 2200 and MA 2160

MSE 3190 - Material Design

Integration of contemporary engineering design methodology with foundational structure-property-processing paradigm for materials design. Introduction to project planning, management, and six-sigma as applied to material design.

Credits: 2.0

Lec-Rec-Lab: (1-0-2)

Semesters Offered: Spring

Pre-Requisite(s): (MY 3100 or MSE 3100) and (MY 3110(C) or MSE 3110(C)) and (MY 3200(C) or MSE 3120(C)) and (MY 3210(C) or MSE 3130(C)) and (MY 3300(C) or MSE 3140(C)) and ENG 1102

MSE 4100 - 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, Summer

Pre-Requisite(s): (MY 2110 or MSE 2110) and (MY 2100 or MSE 2100) and (MEEM 2150 or ENG 2120)

MSE 4110 - Introduction to Polymer Engineering

Introductory study of polymeric materials and polymer engineering. Basics in polymer science including molecular characteristics, synthesis, structure and properties of polymers, with strong emphasis on thermodynamics 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 or MSE 2100) and CH 1160

MSE 4120 - 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 or MSE 2100

MSE 4130 - Materials Science & Engineering Senior Design Project I

Conducted in teams of students working with industrial partners. Open to all engineering majors interested in interdisciplinary senior design projects. Non-MSE majors must be senior project ready as defined by their major program and obtain permission of the MSE department.

Credits: 2.0

Lec-Rec-Lab: (0-0-6)

Semesters Offered: Fall, Spring

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

Pre-Requisite(s): (MY 3110 or MSE 3110) and (MY 3200 or MSE 3120) and (MY 3210 or MSE 3130) and (MY 3300 or MSE 3140) and (MY 4940 or MSE 3190)

Materials Science & Engineering

MSE 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)

MSE 2110 - Introduction to Materials Science and Engineering II

Course is designed to address core competencies in the materials discipline. Materials processing methods are used as a vehicle to master concepts such as crystallography, imperfections, phase diagrams, microstructure, and development of mathematical skills and introduction to computational tools.

Credits: 3.0

Lec-Rec-Lab: (0-2-3)

Semesters Offered: Fall, Spring

Pre-Requisite(s): (MY 2100 or MSE 2100) and (ENG 1100 or ENG 1101)

MSE 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 or MSE 2100) and MA 2160

MSE 3110 - Materials Processing II

A continuation of Materials Processing I, which introduces the fundamental theories and equations governing transport phenomena. Topics include fluid flow, heat flow, diffusion, and chemical kinetics. Discusses the relationships between these subjects and the thermodynamic concepts covered in Materials Processing I.

Credits: 4.0

Lec-Rec-Lab: (4-0-0)

Semesters Offered: Spring

Pre-Requisite(s): (MY 2110 or MSE 2110) and (MY 3100 or MSE 3100) and (MA 3520 or MA 3521 or MA 3530 or MA 3560)

MSE 3120 - 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: Spring

Pre-Requisite(s): (MY 2100 or MSE 2100) and (MY 2110 or MSE 2110)

MSE 4131 - Capstone Professional Skills 1

This course will include practical application of contemporary engineering design methodology within the structure-processing-properties paradigm for material design project management, experimental design, written and oral communication.

Credits: 1.0

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Major(s): Materials Science and Engrg

Co-Requisite(s): ENT 4950

Pre-Requisite(s): MSE 3190 or MY 4940

MSE 4140 - Materials Science & Engineering Senior Design Project II

Senior design project conducted in teams of students working with an industrial partner. Open to all engineering majors interested in interdisciplinary senior design projects. Senior project ready as defined by major substitutes for prerequisites.

Credits: 2.0

Lec-Rec-Lab: (0-0-6)

Semesters Offered: Fall, Spring

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

Pre-Requisite(s): MY 4920 or MSE 4130

MSE 4141 - Capstone Professional Skills 2

This course includes practical application of contemporary engineering design methodology within the structure- processing-properties paradigm for material design, project management, experimental design, written and oral communication.

Credits: 1.0

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Major(s): Materials Science and Engrg

Co-Requisite(s): ENT 4960

Pre-Requisite(s): MSE 4131

MSE 4235 - Fundamentals of Corrosion

Basic mechanisms of electrochemical processes and corrosion.

Credits: 1.0

Lec-Rec-Lab: (1-0-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Class(es): Senior

Pre-Requisite(s): CH 1150 and CH 1151

MSE 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

MSE 4292 - Light and Photonic Materials

Material properties controlling light wave propagation in optical crystals and optical wave guides. Photonic crystals and photonic devices based on electrical, magnetic, and strain effects.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

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

MSE 4310 - 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 or MSE 2100

MSE 4320 - Corrosion and Environmental Effects

Mechanisms of corrosion processes, electrochemical and oxidation kinetics, and fundamentals of corrosion engineering.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

Pre-Requisite(s): MY 2100 or MSE 2100

MSE 4330 - Advanced Physical Metallurgy

Examines what exactly makes a particular industrial alloy useful. From the light metals (aluminum, magnesium and titanium) to the heavy weights (nickel and high alloy steels), this course examines the structure, properties, and processing of metals into industrially useful materials. Covers internationally accepted alloy designations, heat treatment standards, modification and processing.

Credits: 3.0

Lec-Rec-Lab: (2-1-0)

Semesters Offered: Spring

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

Pre-Requisite(s): (MY 2100 or MSE 2100) and (MY 3300 or MSE 3140)

MSE 4410 - 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 or MSE 2100

MSE 4430 - 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 or MSE 2100

MSE 4510 - Contact Mechanics and Nanoindentation

The application of elastic and plastic contact mechanics in relation to nanoindentation with emphasis on the application of instrumentation, models and experimental techniques used to examine the small-scale mechanical behavior of metals, ceramics, polymers, composites, biomaterials, hydrogels, and structured devices.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring

Pre-Requisite(s): (MY 2100 or MSE 2100) and PH 2200 and (MA 3521 or MA 3520 or MA 3530) and MEEM 2150

MSE 4520 - Materials Forensics

Probes fundamental physical principles important to various characterization techniques used to understand crystal structure, microstructure, and substructure in materials. Application of x-ray, electrons, and light to unravel the structural mystery of materials and apply techniques to material failure analysis.

Credits: 3.0

Lec-Rec-Lab: (2-0-3)

Semesters Offered: Fall

Pre-Requisite(s): (MY 2100 or MSE 2100) and (MY 3200 or MSE 3120)

MSE 4525 - 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: On Demand

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

MSE 4530 - Scanning Electron Microscopy and X-ray Microanalysis

Topics include electron beam and image formation, beam- specimen interactions, and x-ray microanalysis. Course content is relevant to students of the physical sciences, engineering, and related disciplines. Includes a laboratory experience that provides hands-on practical training sufficient to enable independent use of the SEM.

Credits: 3.0

Lec-Rec-Lab: (2-0-3)

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior

MSE 4540 - Computational Materials Science: Theory, Modeling, Simulation, and Practice

Theories of materials science from first principles to constitutive laws. Materials modeling and computer simulation at multiple length and time scales. Laboratory practice of various computational methods.

Credits: 3.0

Lec-Rec-Lab: (2-0-3)

Semesters Offered: Spring

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

MSE 4740 - Hydrometallurgy/Pyrometallurgy

Extraction and refining of metals and industrial chemicals from natural and recycled materials. Includes solution- chemistry processes (hydrometallurgy) and thermochemical processes (pyrometallurgy).

Credits: 4.0

Lec-Rec-Lab: (3-1-0)

Semesters Offered: Spring

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

Pre-Requisite(s): CH 1122 or (CH 1160 and CH 1161)

MSE 4760 - 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

MSE 4777 - Distributed Additive Manufacturing Using Open-Source 3-D Printing

This course provides an overview of open-source hardware in theory and practice for an introduction to distributed additive manufacturing using open-source 3-D printing. Each student will build a customized RepRap and will learn all hardware and software for maintaining it.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following College(s): College of Engineering; Must be enrolled in one of the following Class(es): Junior, Senior

MSE 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

MSE 4990 - Undergraduate Research

Undergraduate research in materials science and engineering. Independent research conducted under the guidance of a faculty member.

Credits: variable to 6.0; May be repeated

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required

Operations & Supply Chain Management**OSM 3000 - Operations and Supply Chain Management**

Fundamental principles of operations and supply chain management; includes strategic importance and relevant interrelated concepts and tools in product/process design, work systems, forecasting, inventory and materials management, just-in-time, scheduling, and capacity management.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall, Spring, Summer

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

Pre-Requisite(s): (MA 1135 or MA 1160 or MA 1161) and (MA 2710 or MA 2720 or MA 3710 or MA 3720 or EET 2010 or BUS 2100)

OSM 3150 - Introduction to Supply Chain Management

An introduction to supply chain management to gain a perspective on integration and coordination issues. Topics include strategy, network design, facility design, sourcing, logistics, forecasting, inventory, relationship management, and global and sustainable supply chain management.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

Pre-Requisite(s): OSM 3000(C)

OSM 3600 - Procurement and Supply Management

Addresses processes that facilitate the management of value added transactions and relationships between supplier and customer organizations. The course examines the management of the business purchasing function, including supplier selection and development, cost management, performance measures, buyer-supplier relationships, and negotiation.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

OSM 4300 - Project Management

The various stages in a project life cycle will be covered and include initiation, planning, execution, and closeout. Basic tools such as the Project Charter, Network Diagrams Gantt, and budgeting will be covered. Basics of MS Project are included.

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): BUS 2100 or CEE 3710 or MA 2720 or MA 3710 or EE 3180 or BE 2100

OSM 4350 - Advanced Project Management

A project oriented business development class focused on real-life and advanced applications of project management techniques. Students participate in a competition, prepare for the PMI CAPM exam, and may sit for the exam to obtain certification.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring

Restrictions: Permission of instructor required; May not be enrolled in one of the following Class(es): Freshman, Sophomore

Pre-Requisite(s): OSM 3200 or ENG 4300 or OSM 4300

OSM 4650 - Six Sigma Fundamentals

Course is framed in context of six sigma methodology. Topics include principles of Shewhart, Deming, Taguchi; meaning of quality; control charts for variables, individuals, and attributes; process capability analysis; variation of assemblies; and computer-based workshops.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall, Spring

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

Pre-Requisite(s): MA 2710 or MA 2720 or MA 3710 or MA 3720 or BUS 2100 or CE 3710 or CEE 3710

OSM 4700 - Logistics and Transportation Management

Focuses on the transportation and distribution services that support demand fulfillment from the receipt of customer orders to order fulfillment. Topics include customer service, order fulfillment, inventory, transportation costs and modes, facility design and operation, carrier selection, and negotiation.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

Pre-Requisite(s): (MA 2710 or MA 2720 or MA 3710 or CE 3710 or CEE 3710) and (MA 1135 or MA 1160 or MA 1161)

OSM 4990 - Special Topics in Supply Chain and Operations Management

Examines additional supply chain and/or operations 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; Repeatable to a Max of 6

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

Pre-Requisite(s): OSM 3000

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 used once as a general education co-curricular course.

Credits: 0.5; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: On Demand

PE 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 I

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, 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: 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, 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: On Demand

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: Spring

PE 0117 - Beginning Hockey

Individual skills, team techniques, rules, and strategies. Requires basic hockey equipment of helmet with face mask, shoulder pads, hockey pants, shin pads, elbow pads, hockey gloves, skates, supporter, jersey, hockey socks, hockey stick. May be used once as a general education co-curricular course.

Credits: 0.5; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring

PE 0118 - Beginning Weight Training

Training methods for physical development using stationary and free weights. May be used once as a general education co-curricular course.

Credits: 0.5; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring, Summer

PE 0119 - Beginning Fitness Training

This course is designed to introduce students to a variety of activities to improve their fitness and well being. Activities will include using aerobic machines and strength training. Students will learn the basic concepts of fitness and how to safely and properly use the fitness center equipment.

Credits: 0.5; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring

PE 0120 - Beginning Alpine Skiing (Downhill)

Beginning skills of alpine skiing techniques taught, evaluated, and recommendations made for improvement. Students with skills above beginner level cannot take this class. Students must provide their own transportation to Mont Ripley. It is recommended that students provide their own equipment. Daily rental and "rent for the season" equipment available at Mont Ripley.

Credits: 0.5; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Spring

PE 0121 - Beginning Snowboarding

Beginning skills of snowboarding techniques taught, evaluated, and recommendations made for improvement. Students must be a beginner or have never snowboarded to this class. Students with skills above beginner level cannot take this class. Students must provide their own transportation to Mont Ripley. It is recommended that students provide 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. A limited amount of rentals are 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 0130 - Water Aerobics

Improvement of fitness and body measurement through water exercise. May be used once as a general education co-curricular course.

Credits: 0.5; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall

PE 0132 - Beginning Soccer

Fundamental skills, techniques, terminology, and rules of soccer. May be used once as a general education co-curricular course.

Credits: 0.5; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Summer

PE 0135 - Beginning Cross Country Skiing

Develop the skills for touring/recreational cross-country skiing. Own equipment is recommended; rental equipment available. May be used once as a general education co-curricular course.

Credits: 0.5; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Spring

PE 0137 - Table Tennis

Fundamental skills of table tennis will be taught. May be used once as a general education co-curricular course.

Credits: 0.5; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring

PE 0138 - Beginning Racquetball/Squash

Fundamentals, rules, and basic strategies of racquetball/squash. Gives students opportunity to play singles, cutthroat, and doubles. Racquets, balls, and eyewear provided. Recommend use of personal racquet. May be used once as a general education co-curricular course.

Credits: 0.5; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring

PE 0139 - Beginning Badminton

Fundamental skills, rules, and scoring of badminton. May be used once as a general education co-curricular course.

Credits: 0.5; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring

PE 0140 - Beginning Tennis

Fundamentals of the game, rules, and etiquette of tennis. Meets at Gates Tennis Center. Non-marking court shoes must be worn. Tennis balls and 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 and helmets.

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: Summer

PE 0151 - Indoor Lifetime Activities

This class will introduce students to a variety of recreational activities often used in a social/leisure setting (i.e., shuffleboard, billiards, table tennis, etc.). May be used once as a general education co-curricular course.

Credits: 0.5; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Spring

PE 0152 - Social Dance I

Fundamentals of social dance, providing the basic skills, concepts of movement, style, and fundamental step patterns. Emphasis on the development of fundamental dance skills and practice in utilizing dance techniques.

Credits: 0.5; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring

PE 0153 - Aerobics I

Improvement of cardiovascular fitness, strength, coordination, and body mechanics through exercise. May be used once as a general education co-curricular course.

Credits: 0.5; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring

PE 0155 - Beginning Road Biking

Learn to be comfortable and confident while riding a regular road bike. Covers basic maintenance repair procedures. Requires own equipment and supplies, including a bike helmet. May be used once as a general education co-curricular course.

Credits: 0.5; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall

PE 0156 - Beginning Mountain Biking

Learn to be comfortable and confident while riding a mountain bike off-road. Covers basic maintenance repair procedures. Requires own equipment and supplies as well as a biking helmet. May be used once as a general education co-curricular course.

Credits: 0.5; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall

PE 0166 - Moving for Fitness

Introductory course to using the Student Development Complex and surrounding outdoor facilities in a variety of group and individual activities. Basic movement at your own level. May be used once as a general education co-curricular course.

Credits: 0.5; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Summer

PE 0167 - Beginning Yoga

Learn the basics or compliment previous experience while improving flexibility, balance and concentration. Improve focus. Relax mentally and physically.

Credits: 0.5; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring

PE 0168 - Beginning Pilates

Students will learn a unique approach to exercise that develops body awareness. Pilates is one of the safest forms of exercise today. Students will improve coordination, posture and flexibility, as well as, release stress. May be used once as a general education co-curricular course.

Credits: 0.5; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring

PE 0169 - Indoor Cycling

High energy, group cycling class. No complicated moves to learn. Upbeat music that gets your legs pumping.

Credits: 0.5; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring

PE 0170 - TaeKwonDo and Hapkido I

Introduction to the basic kicking, blocking, punching, joint locking, and self-defense 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 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 0176 - Outdoor Adventure

Students will engage in multi-day backpacking with overnight camping. Destinations are variable, possibilities include Isle Royale National Park, Porcupine Mountains, etc. Instructors will include trained wilderness guides and class/laboratory fee will cover miscellaneous costs such as park permits, transportation costs, camping gear, and group meals.

Credits: variable to 3.0; Repeatable to a Max of 3; Graded Pass/Fail Only

Semesters Offered: On Demand

PE 0205 - Bowling II

Intermediate to advanced techniques in bowling, including skills and strategy involved in tournament play. May be used once as a general education co-curricular course.

Credits: 0.5; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring

PE 0206 - Intermediate Golf

Intermediate to advanced individual instruction in golf techniques, terms, courtesies, and tournament regulations. Equipment needed; some rental clubs available. May be used once as a general education co-curricular course.

Credits: 0.5; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Summer

PE 0209 - Intermediate Aikido

This course is designed to be a continuation of Aikido.

Credits: 0.5; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: On Demand

PE 0210 - Special Topics in Physical Education

Unconventional activity courses that address varying and changing student interests. Topics vary. Each topic may count once as a general education co-curricular course as long as the topic and course content are different than other co-curricular courses taken.

Credits: 0.5; Repeatable to a Max of 1; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring, Summer

PE 0215 - Intermediate Swimming

Students learn to swim four basic strokes with proficiency. Requires ability to swim the length of pool comfortably. May be used once as a general education co-curricular course.

Credits: 0.5; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring

PE 0216 - Intermediate Basketball

Intermediate to advanced techniques, skills, and strategies of basketball. May be used once as a general education co-curricular course.

Credits: 0.5; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: 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

PE 0219 - Intermediate Fitness Training

This course is designed to be a continuation of Beginning Fitness Training, providing the opportunity to continue in a variety of activities to improve fitness and well being. Activities include using aerobic machines and strength training. Students will learn fitness training concepts and how to safely and properly use fitness center equipment.

Credits: 0.5; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring

PE 0220 - Intermediate Alpine Skiing (Downhill)

Intermediate to advanced skills of alpine skiing techniques taught, evaluated and recommendations made for improvement. Students must provide their own transportation to Mont Ripley. It is recommended that students provide their own equipment. Daily rental and "rent for the season" equipment available at Mont Ripley. May be used once as a general education co-curricular course.

Credits: 0.5; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Spring

PE 0221 - Intermediate Snowboarding

Intermediate to advanced skills of snowboarding techniques taught, evaluated, and recommendations made for improvement. Students must provide their own transportation to Mont Ripley. It is recommended that students provide their own equipment. Daily rental and "rent for the season" equipment available at Mont Ripley. May be used once as a general education co-curricular course.

Credits: 0.5; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Spring

PE 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 0230 - Water Polo

Fundamental skills, rules, strategy, and play of water polo. May be used once as a general education co-curricular course.

Credits: 0.5; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring

PE 0232 - Intermediate Soccer

Intermediate to advanced techniques, skills, and strategies involved in soccer. May be used once as a general education co-curricular course.

Credits: 0.5; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring, Summer

PE 0235 - Intermediate Cross Country Skiing

Development of touring, recreational, and racing skills in cross country skiing. Own equipment is recommended; rental equipment available. Basic skills evaluated to ensure proper level of skiing proficiency. May be used once as a general education co-curricular course.

Credits: 0.5; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Spring

PE 0237 - Intermediate Table Tennis

Intermediate/advanced skills of table tennis will be taught. May be used once as a general education co-curricular course.

Credits: 0.5; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring

PE 0238 - Intermediate Racquetball/Squash

Reviews the fundamentals and instructs the students on the intermediate/advanced skills of racquetball and squash. Gives all students the opportunity to play singles, cutthroat, and doubles. Racquets, balls, and 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

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 0250 - Paintball

Students will be exposed to the sport of paintball for enjoyment and physical exercise in a relaxed outdoor setting. May be used once as a general education co-curricular course.

Credits: 0.5; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring

PE 0252 - Social Dance II

Continuation of developing social dance skills, concepts of movement, style, and step patterns. Emphasis on practice in utilizing dance techniques.

Credits: 0.5; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring

PE 0253 - Aerobics II

Intermediate to advanced techniques and steps involved in aerobics. Requires previous aerobics experience. May be used once as a general education co-curricular course.

Credits: 0.5; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring

PE 0256 - Intermediate Mountain Biking

Intermediate to advanced techniques and skills involved in mountain biking. May be used once as a general education co-curricular course.

Credits: 0.5; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall

PE 0266 - Running for Fitness

The techniques, skills, and strategies involved in running. The class is physically strenuous. Requires appropriate running shoes and attire. May be used once as a general education co-curricular course.

Credits: 0.5; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring, Summer

PE 0267 - Intermediate Yoga

Combined ancient Hatha yoga poses with modern fitness movement to create a total mind/body workout for all fitness levels. Improve breathing and oxygen intake.

Credits: 0.5; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring

PE 0268 - Intermediate Pilates

Students will learn advanced techniques to build strength and flexibility while engaging the muscles of their abdominals, lower back and hips, otherwise known as the "Power House" for a more streamline shape.

Credits: 0.5; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring

PE 0270 - Cardio TaeKwonDo

Improvement of kicking, blocking, punching, joint locking, and self-defense techniques. Emphasizes improvement of skills and strategies involved in TaeKwonDo. May be used once as a general education co-curricular course.

Credits: 0.5; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring

PE 0315 - Fitness Swimming

Practices the basic strokes; introduces knowledge in creating workouts to encourage swimming as a lifetime fitness activity. May be used once as a general education co-curricular course.

Credits: 0.5; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Spring

PE 0320 - Advanced Skiing

Advanced skills of skiing techniques taught, evaluated, and recommendations made for improvement. Students must provide their own transportation to Mont Ripley. It is recommended that students provide their own equipment. Daily rental and "rent for the season" equipment available at Mont Ripley. May be used once as a general education co-curricular course.

Credits: 0.5; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Spring

PE 0321 - Advanced Snowboarding

Advanced skills of snowboarding techniques taught, evaluated, and recommendations made for improvement. Students must provide their own transportation to Mont Ripley. It is recommended that students provide their own equipment. Daily rental and "rent for the season" equipment available at Mont Ripley. May be used once as a general education co-curricular course.

Credits: 0.5; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Spring

PE 0330 - Club Sports

Club sport participation based on student interest. Group must be on the approved list of sports and all membership requirements must be up to date. Students enrolling in this course must participate in 14 hours of activity during the semester. Participation is tracked by instructor of record. No retroactive credit will be awarded for involvement in club sport activity.

Credits: 0.5; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring

Restrictions: Permission of instructor required

PE 0340 - Advanced Tennis

Advanced skills and strategy to make play more efficient. Multiple spins on forehand and backhand, ground strokes, drop shots, and different types of serves. Non-marking court shoes must be worn. May be used once as a general education co-curricular course.

Credits: 0.5; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Spring

Pre-Requisite(s): PE 0240

PE 0352 - Social Dance III

Introduction of current dance trends.

Credits: 0.5; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring

PE 0353 - Aerobics III

Cardiovascular fitness course based on current trends in aerobics.

Credits: 0.5; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring

PE 0355 - Advanced Road Biking

Learn advanced road biking techniques and strategies. Course requires own equipment, including road bike/wheels, bike shorts, biking shoes/pedals, and a helmet. Course also requires sufficient fitness to ride continuously in excess of 15 mph for 1.5 hours. May be used once as a general education co-curricular course.

Credits: 0.5; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall

PE 0367 - Mindful Yoga

A restorative yoga class that is very gentle and has an emphasis on meditations/mindfulness.

Credits: 0.5; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring

PE 0420 - Ski Instructor Training

Students will learn how to teach ski classes. Upon completion of this course students will have the knowledge to complete the Level I certification test with the American Snowsports Education Association, if they choose.

Credits: 0.5; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: On Demand

PE 0421 - Snowboard Instructor Training

Students will learn to teach snowboard classes. Upon completion of this course students will have the knowledge to complete the Level I certification test with the American Snowsports Education Association, if they choose.

Credits: 0.5; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: On Demand

PE 0425 - Intramurals

Intramural activity that addresses varying and changing student interests. Sports vary. Students must be a member of IMleagues.com/MTU. Students enrolling in the course must participate in 14 games/contests during the portion of the semester that the course is offered to receive a passing grade. Participation is tracked via IMleagues.com/MTU. No retroactive credit will be awarded for involvement in intramural activities.

Credits: 0.5; Repeatable to a Max of 1; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring

Restrictions: May not be enrolled in one of the following Class(es): Freshman

PE 0430 - Club Sports Leadership

Leadership in club sport participation based on student interests. Students enrolling in this course must hold a position of leadership within the club sport. Group must be on approved list of sports and all membership requirements up to date. Students must participate in 14 hours of leadership activity during the semester. Participation is tracked by instructor of record. No retroactive credit will be awarded for involvement in club sport activity.

Credits: 0.5; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring

Restrictions: Permission of instructor required

PE 0450 - Physical Education Fusion-Full

Students will submit activity logs, photos, etc. to the course site. A predetermined number of points will need to be earned doing various activities through the semester. Activities with point values will be posted on the electronic course site.

Credits: 1.0; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-3)

Semesters Offered: Fall, Spring, Summer

PE 1000 - 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 1028 - Ski Patrol (Hill)

National Ski Patrol training involving fitness, skiing proficiency, toboggan handling, and lift evacuation. Leads to qualifying membership test into National Ski Patrol. Requires payment of dues to become a member of National Ski Patrol. Participation in this course requires intermediate ski level. Students must provide own equipment. Some rentals available at Mont Ripley.

Credits: 1.0; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-4)

Semesters Offered: Spring

PE 1101 - Team Sports

Students will demonstrate fundamental skills, knowledge of rules, strategies, and safety of the following team sports necessary for participation: flag football, softball, volleyball, soccer, basketball, and floor hockey. Students should bring a glove for softball. May be used once as a general education co-curricular course.

Credits: 1.0; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring

PE 1105 - Bowling

Students will learn skills, rules, and scoring of bowling. Including skills and strategy involved in tournament play. May be used once as a general education co-curricular course.

Credits: 1.0; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring

PE 1106 - 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: 1.0; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-4)

Semesters Offered: Fall, Spring

PE 1113 - Disc Sports

Students will demonstrate fundamental skills, knowledge of rules, strategies, and safety disc golf, frisboockey, and ultimate frisbee. Equipment provided. May be used once as a general education co-curricular course.

Credits: 1.0; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring

PE 1118 - Weight/Fitness Training

This course is designed to introduce students to a variety of weight and fitness activities to improve their well-being. Activities will include using aerobic and strength training machines. Students will learn basic concepts on how to safely and properly use the fitness center equipment. May be used once as a general education co-curricular course.

Credits: 1.0; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring

PE 1119 - Conditioning

Students will demonstrate the fundamental knowledge and skills of conditioning, leading to continued enjoyment and participation as a lifelong activity. May be used once as a general education co-curricular course.

Credits: 1.0; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring

PE 1138 - Raquet Sports

Students will demonstrate fundamental skills, knowledge of rules, strategies, and safety of table tennis, racquetball, and badminton. Equipment provided. May be used once as a general education co-curricular course.

Credits: 1.0; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring

PE 1140 - Tennis

Fundamentals of the game, rules, and etiquette of tennis. 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: 1.0; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring

PE 1170 - TaeKwonDo

Introduction to the basic kicking, blocking, punching, joint locking, and self-defense techniques of TaeKwonDo and Hapkido. Emphasizes improvement of flexibility, skills and strategies. May be used once as a general education co-curricular course.

Credits: 1.0; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring

PE 1210 - Special Topics

Unconventional activity courses that address varying and changing student interests. Topics vary. May count once as a general education co-curricular course.

Credits: 1.0; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring

PE 1215 - Introduction to Backcountry Travel

Fundamental knowledge and skills of backpacking leading to continued enjoyment and participation as a lifelong activity. Students will learn/practice on how to pack a backpack, plan food, and be knowledgeable about proper care and use of equipment related to backpacking.

Credits: 1.0; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-4)

Semesters Offered: Fall

PE 1220 - Introduction to Canoeing

Fundamental knowledge and skills of canoeing leading to continued enjoyment and participant as a lifelong activity. Students will practice/learn the basic strokes, and be knowledgeable about proper care and use of equipment related to canoeing.

Credits: 1.0; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-4)

Semesters Offered: Fall

PE 1225 - Indoor Rock Climbing

Fundamental knowledge and skills of rock climbing leading to continued enjoyment and participation as a lifelong activity. Students will practice/learn the basic terminology, knots, equipment, policies and procedures, and be knowledgeable in the proper care and use of equipment related to climbing, as well as safety concerns when climbing.

Credits: 1.0; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring

PE 1230 - Introduction to Kayaking

Fundamental knowledge and skills of kayaking leading to continued enjoyment and participation as a lifelong activity. Students will learn/practice basic strokes, and be knowledgeable in the proper care and uses of equipment related to kayaking, as well as safety concerns when kayaking.

Credits: 1.0; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-4)

Semesters Offered: Fall

PE 1235 - Introduction to Log Rolling

Fundamental knowledge and skills of log rolling as a sport, the different steps including front, back, and skip steps, and techniques of getting on the log. Log rolling is a different style of workout that works on balance, core, and endurance. History of Log Rolling and current competitive opportunities will be covered.

Credits: 1.0; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring, Summer

PE 1240 - Snowshoeing

Fundamental knowledge and skills of snowshoeing leading to continued enjoyment and participation as a lifelong activity. Students will learn about equipment, proper care and storage of equipment, and basic concepts of snowshoeing.

Credits: 1.0; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-4)

Semesters Offered: Spring

PE 1245 - Wilderness First Responder

The definitive wilderness course in medical training, leadership, and critical thinking for outdoor, low-resource, and remote professionals and leaders. This course is the ideal medical training for leaders in remote areas, as well as general recreation users in remote in wild settings.

Credits: 1.0; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-4)

Semesters Offered: On Demand

PE 1435 – Self Defense for Women

The Rape Aggression Defense System is a program of realistic, self-defense tactics and techniques. The R.A.D. System is a comprehensive course for women that begins with awareness, prevention, risk reduction and avoidance, while progressing on to the basics of hands-on defense training. R.A.D. is not a martial arts program.

Credits: 1.0; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring

PE 1436 - Self Defense for Men

Course teaches the Rape Aggression Defense System for men (TM). Participants will have the opportunity to raise their awareness of aggressive behavior. Hands-on self-defense skills to resist and escape aggressive behavior will be practiced.

Credits: 1.0; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring

PE 2010 - Varsity Football

Selective collegiate-level sports participation requiring an elite level of skill and extensive time commitment. May be used once as a general education co-curricular course.

Credits: 1.0; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-5)

Semesters Offered: Fall

Restrictions: Permission of department required

PE 2020 - Varsity Basketball

Selective collegiate-level sports participation requiring an elite level of skill and extensive time commitment. May be used once as a general education co-curricular course.

Credits: 1.0; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-5)

Semesters Offered: Fall, Spring

Restrictions: Permission of department required

PE 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

Physics

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, Summer

Pre-Requisite(s): PH 1090(C)

PH 1100 - Physics by Inquiry I

Experiments covering kinematics, force, conservation of momentum, conservation of energy, and waves are explored through guided construction. The course emphasizes understanding physical concepts through inquiry and the scientific method

Credits: 1.0

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring, Summer

Pre-Requisite(s): MA 1160(C) or MA 1161(C)

PH 1110 - College Physics I

An overview of basic principles of kinematics, dynamics, elasticity, fluids, heat, thermodynamics, mechanical waves, and interference and diffraction of mechanical waves.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall, Summer

Restrictions: May not be enrolled in one of the following College(s): School of Technology, College of Engineering; May not be enrolled in one of the following Major(s): Physics, Applied Physics

Co-Requisite(s): PH 1111

Pre-Requisite(s): MA 1031 or MA 1032 or MA 1135(C) or MA 1160(C) or MA 1161(C) or ALEKS Math Placement \geq 56 or CEEB Calculus AB \geq 2 or CEEB Calculus BC \geq 2 or CEEB Calculus AB Subscore \geq 2

PH 1111 - College Physics I Laboratory

Experiments covering kinematics, forces, conservation of momentum and energy, waves, and thermodynamics are explored through guided construction. The course provides inquiry-based laboratory experiences for concepts explored in PH1110.

Credits: 1.0

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Summer

Restrictions: May not be enrolled in one of the following College(s): School of Technology, College of Engineering; May not be enrolled in one of the following Major(s): Physics, Applied Physics

Co-Requisite(s): PH 1110

PH 1140 - Applied College Physics I

An algebra-based introduction to classical mechanics and its applications. Topics include kinematics, Newton's laws, impulse and momentum, work and energy, simple harmonic motion, mechanical waves and sound, and temperature and heat.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Major(s): Construction Management, Mechanical Engineering Tech, Electrical Eng Tech, General Technology, Theatre & Entertain Tech (BS), Computer Network & System Admn

Co-Requisite(s): PH 1141

Pre-Requisite(s): MA 1031 or MA 1032 or MA 1160(C) or MA 1161(C) and (PH 1100 or PH 1111 or PH 1141(C) or PH 1161)

PH 1141 - Applied College Physics I Laboratory

Experiments covering kinematics, forces, conservation of momentum and energy, waves, and thermodynamics are explored through guided construction. The course provides inquiry-based laboratory experiences for concepts explored in PH1140.

Credits: 1.0

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Major(s): Engineering Technology, Mechanical Engineering Tech, Computer Network & System Admn, Electrical Eng Tech, Theatre & Entertain Tech (BS), Construction Management

Co-Requisite(s): PH 1140

PH 1160 - Honors Physics I - Mechanics

Calculus-based introduction to classical mechanics. Topics include mathematical concepts, kinematics, Newton's laws, the gravitational force, work and energy, and collisions. Also introduces departmental facilities, research within the department, and professional opportunities in physics. Intended for physics majors; highly motivated students seeking an invigorating introduction to physics may enroll with permission of the instructor.

Credits: 4.0

Lec-Rec-Lab: (4-0-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Major(s): Physics (BA), Physics, Applied Physics

Co-Requisite(s): PH 1161

Pre-Requisite(s): MA 1160(C) or MA 1161(C) or MA 2160(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 (BA), Physics, Applied Physics

Co-Requisite(s): PH 1160

PH 1200 - Physics by Inquiry II

Experiments covering Coulomb's law, electric and magnetic fields, circuits, induction, and geometric optics are explored through guided construction. The course emphasizes understanding physical concepts through inquiry and the scientific method.

Credits: 1.0

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring, Summer

Pre-Requisite(s): PH 1100 or PH 1111 or PH 1141 or PH 1161

PH 1210 - College Physics II

An overview of basic principles of static and dynamic electricity and magnetism, electromagnetic waves, reflection and refraction of light, interference and diffraction of light, special theory of relativity, wave theory of matter, particle theory of electromagnetic waves, theory of the atom, the nucleus, and elementary particles.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall, Spring, Summer

Restrictions: May not be enrolled in one of the following College(s): School of Technology, College of Engineering; May not be enrolled in one of the following Major(s): Physics, Applied Physics

Pre-Requisite(s): PH 1200(C) and (PH 1110 or PH 1100)

PH 1240 - Applied College Physics II

An overview of static and dynamic electricity and magnetism, electromagnetic waves, basic optics, and an introduction to modern and nuclear physics with an emphasis on problem solving and applications.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following College(s): School of Technology

Co-Requisite(s): PH 1200

Pre-Requisite(s): PH 1140 or PH 1110

PH 1360 - Honors Physics II - Rotation and Vibration

Continuation of PH 1160. Topics include rotational motion, simple harmonic motion and mechanical waves. Offered first half of spring semester.

Credits: 2.0

Lec-Rec-Lab: (4-0-0)

Semesters Offered: Spring

Co-Requisite(s): PH 1361

Pre-Requisite(s): (PH 1160 or PH 2100) and MA 2160(C)

PH 1361 - Introductory Experimental Physics II

Laboratory complement to PH 1360. Waves and thermodynamics are explored through guided construction. The course emphasizes understanding physical concepts through inquiry and the scientific method.

Credits: 1.0

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Spring

Co-Requisite(s): PH 1360

PH 1500 - Extraordinary Concepts in Physics

Extraordinary concepts will be surveyed. Included will be time dilation and length contraction in Special Relativity, physics of Time Travel, curvature in General Relativity, interpretations of Uncertainty Principle, counter-intuitive examples of Two-Slit Experiment, Schrodinger's Cat, Maxwell's Demon, Bell's Inequality, curvature in cosmology, dark matter, dark energy, black hole evaporation, string theory, and gravitational lensing.

Credits: 2.0

Lec-Rec-Lab: (2-0-0)

Semesters Offered: On Demand

PH 1600 - Introductory Astronomy

Introduces fundamentals of astronomy. Topics include Kepler's and Newton's laws of motion, origin and evolution of the solar system, galactic astronomy, extra-galactic astronomy, cosmology, and modern instrumentation, including space-based astronomy.

Credits: 2.0

Lec-Rec-Lab: (2-0-0)

Semesters Offered: Fall, Spring, Summer

PH 1610 - Introductory Astronomy Lab

Demonstrates fundamentals of astronomy using non-telescopic and telescopic observations, and computer simulations. Topics include angular size measurements, season-dependent measurements, phases of the moon, phases and orbits of planets, brightness of stars, introduction to the use of MTU's Observatory, instrumentation, and applications of computer programs involving cosmology.

Credits: 1.0

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring, Summer

Co-Requisite(s): PH 1600

PH 2020 - Introduction to Scientific Programming and Error Analysis

Compiled programming languages, command lines, and scripts will be used to solve simple physics problems. Measurement uncertainties, significant figures, probability distributions, error propagation, and data reduction will be examined in the contexts of experiments and numerical calculations.

Credits: 2.0

Lec-Rec-Lab: (1-0-2)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Major(s): Physics (BA), Physics, Applied Physics

Pre-Requisite(s): (PH 1160 or PH 2100) and (MA 1160 or MA 1161)

PH 2100 - University Physics I-Mechanics

A calculus-based introduction to classical mechanics. Topics include kinematics, Newton's laws, impulse and momentum, work and energy, and the universal law of gravitation.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall, Spring, Summer

Pre-Requisite(s): PH 1100(C) and (MA 1160 or MA 1161 or MA 1135 or MA 2160(C))

PH 2200 - University Physics II-Electricity and Magnetism

A calculus-based introduction to electromagnetism. Topics include Coulomb's law, electric fields, Gauss's law, electric potential, capacitance, circuits, magnetic forces and fields, Ampere's law, induction, Maxwell's equations, and electromagnetic waves.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall, Spring, Summer

Pre-Requisite(s): (PH 1200(C) or PH 2261(C)) and (PH 2100 or PH 1160) and MA 2160

PH 2230 - Electronics for Scientists

An introduction to analog and digital electronics with an emphasis on their use in the laboratory. Topics include linear devices and basic linear circuit analysis; diodes; transistors; op-amps; the use of digital components, including logic gates, flip-flops, counters, clocks and microcontrollers, and analog to digital conversions.

Credits: 4.0

Lec-Rec-Lab: (3-0-3)

Semesters Offered: Spring

Restrictions: May not be enrolled in one of the following Major(s): Electrical Engineering, Computer Engineering

Pre-Requisite(s): PH 2200 or PH 2260

PH 2260 - Honors Physics III - Electricity and Magnetism

Calculus-based introduction to electromagnetism. Topics include Coulomb's law, electric fields, Gauss's law, electric potential, capacitance, circuits, magnetic forces and fields, Ampere's law, induction, Maxwell's equations, electromagnetic waves and geometrical optics.

Credits: 4.0

Lec-Rec-Lab: (4-0-0)

Semesters Offered: Fall

Pre-Requisite(s): (PH 1160 or PH 2100) and (PH 1200(C) or PH 2261(C)) and MA 2160

PH 2261 - Introduction to Experimental Physics III

A laboratory complement to PH2260. Experiments covering Coulomb's law, electric and magnetic fields, circuits, induction, geometric optics, and modern physics are explored through guided construction. The course emphasizes understanding physical concepts through inquiry and the scientific method.

Credits: 1.0

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall

Co-Requisite(s): PH 2260

Pre-Requisite(s): PH 1100 or PH 1161

PH 2300 - University Physics III-Fluids and Thermodynamics

A calculus-based introduction to fluids and thermal physics. Topics include fluid motion, propagation of heat and sound, temperature and the kinetic theory of gases, heat capacity and latent heat, first law of thermodynamics, heat engines and the second law, entropy, and an introduction to statistical mechanics. Offered second half of spring semester.

Credits: 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, Summer

Pre-Requisite(s): PH 2200 or PH 2260

PH 3110 - Theoretical Mechanics I

An intermediate study of mechanics, including the study of Newtonian mechanics of a single particle and multiple-particle systems, oscillations, motion in noninertial reference frames, gravitation and central-force motion, and Lagrangian mechanics.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

Pre-Requisite(s): (PH 2200 or PH 2260) and (MA 3520 or MA 3521 or MA 3530 or MA 3560)

PH 3111 - Theoretical Mechanics II

A continuation of PH3110. Includes the study of the rigid body motion, relativistic mechanics, and coupled oscillations. Additional topics may include chaos theory, Hamiltonian mechanics, and continuous systems.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring

Pre-Requisite(s): PH 3110

PH 3210 - Optics

An introduction to geometrical and physical optics. Topics in geometrical optics include ray analysis of mirrors, lenses, prisms, and optical systems. Topics in physical optics include polarization, interference, interferometry, and diffraction. The laboratory explores optics through experiments in imaging, fiber optics, interferometry, diffraction, polarization, and laser beam propagation.

Credits: 3.0

Lec-Rec-Lab: (2-0-3)

Semesters Offered: Fall

Pre-Requisite(s): PH 2400 and (MA 3520 or MA 3521 or MA 3530(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) and (PH 2200 or PH 2260)

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, electrodynamics, and electromagnetic waves.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring

Pre-Requisite(s): PH 4210

PH 4292 - Light and Photonic Materials

Material properties controlling light wave propagation in optical crystals and optical waveguides. Photonic crystals and photonic devices based on electrical, magnetic, and strain effects.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

Pre-Requisite(s): PH 2200(C)

PH 4390 - Computational Methods in Physics

An overview of numerical and computer methods to analyze and visualize physics problems in mechanics, electromagnetism, and quantum mechanics. Utility and potential pitfalls of these methods, basic concepts of programming, UNIX computing environment, system libraries and computer graphics are included.

Credits: 3.0

Lec-Rec-Lab: (2-0-3)

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: (2-0-3)

Semesters Offered: Spring

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 - Fundamentals of Atmospheric Science

Fundamental principles of atmospheric science including thermodynamics, aerosol and cloud physics, radiative transfer, and atmospheric dynamics.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2013-2014 academic year

Pre-Requisite(s): (PH 2200 or PH 2260) and (PH 1360 or PH 2300) and MA 3160 and (MA 3520 or MA 3521 or MA 3530 or MA 3560)

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: On Demand

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: On Demand

Pre-Requisite(s): PSY 2000

PSY 2300 - Developmental Psychology

A survey of human development across the life span (prenatal, infant, child, adolescent, and adult) in the areas of biological, cognitive, social, emotional, and personality development. Provides insight into both the universality of human development and the uniqueness of individuals.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring, Summer

Pre-Requisite(s): PSY 2000

PSY 2400 - Health Psychology

Examines the theoretical, empirical, and historical bases for health psychology. Topics may include the effects of stress, determinants of addictive behavior, the impact of psychological factors on physical health, obesity, and the causes and treatment of chronic pain.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Pre-Requisite(s): PSY 2000

PSY 2501 - Intro to the Psychology Major

Psychology majors examine the field of psychology and major degree requirements resulting in an undergraduate plan of study focused on graduate school admission or career preparation. Students will be introduced to department research and other opportunities.

Credits: 1.0

Lec-Rec-Lab: (0-1-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Major(s): Psychology;

Must be enrolled in one of the following Class(es): Freshman, Sophomore

Pre-Requisite(s): PSY 2000(C)

PSY 2600 - Psychology of Death and Dying

An examination of theory, research, and issues in the psychology of death and dying. Topics may include the development of death concepts, death anxiety in society, the needs of the dying person, the psychology of grieving, and unexpected losses.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2018-2019 academic year

Pre-Requisite(s): PSY 2000

PSY 2720 - Statistics for the Behavioral Sciences

An understanding of statistical concepts and ability to conduct statistical analyses (using both hand calculation and SPSS) as used in Social and Behavioral Sciences research. Topics include descriptive statistics, correlation, and inferential statistics through ANOVA.

Credits: 4.0

Lec-Rec-Lab: (0-3-3)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Major(s): Social Sciences, Psychology

Pre-Requisite(s): MA 1031 or MA 1032 or MA 1160(C) or MA 1161(C) or MA 1135(C)

PSY 2800 - Critical Thinking for Social and Behavioral Sciences

This course will help develop critical thinking skills central to the social and behavioral sciences. Topics may include arguments, logic, evaluating causal claims, evaluating surveys, theory evaluation, experiment evaluation, writing in psychology, and ethical considerations in the social and behavioral sciences.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring

Pre-Requisite(s): PSY 2000(C)

PSY 3000 - Research Methods & Stats

Introduction to experimental design, general research methodology, computer analysis and interpretation of data. Emphasizes issues and methods involved in psychological research. Topics include experimental design and validity, choosing appropriate data analysis techniques, statistical analysis, and APA writing style.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

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 (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 and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

PSY 3020 - Moral Psychology

This course focuses on moral behavior and reasoning informed by empirical science and philosophy. Topics may include moral motivation, moral responsibility, character traits, virtues, cross-cultural differences, reactive attitudes, moral development, and applied issues.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2014-2015 academic year

Pre-Requisite(s): PSY 2000 and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

PSY 3030 - Abnormal Psychology

Helps the student build an understanding of abnormal behavior through critical examination of historical and contemporary models used in this field. The student learns the causes and treatment proposed by Cognitive-Behavioral, Psychodynamic and Sociocultural Models with particular emphasis placed on the Diagnostic and Statistical manual used by clinicians for diagnoses.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Pre-Requisite(s): PSY 2000 and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

PSY 3040 - History and Systems of Psychology

Traces major historical contributions to current psychology from ancient to modern times. Examines significant ideas and discoveries from philosophy, mathematics, and the natural and medical sciences as they relate to the development of psychology. Discusses philosophical, theoretical, and methodological controversies that surfaced as part of these historical developments.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Pre-Requisite(s): PSY 2000

PSY 3060 - Physiological Psychology

Study of the relations between psychological manipulations and resulting physiological responses to promote understanding of mind/body interaction. Will examine psychophysiological measurement methods, research, and the application of psychophysiology.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Pre-Requisite(s): PSY 2000 and (BL 1020 or BL 1040 or BL 1010)

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: Fall - Offered alternate years beginning with the 2019-2020 academic year

Pre-Requisite(s): PSY 2000 and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

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 3100 - Applied Counseling Techniques

An applied review of counseling techniques, their strengths and weaknesses, and the fundamental concepts that support the use of each type of counseling. This is a course in which students will be required to apply and practice one of the counseling techniques with a voluntary client.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2018-2019 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman

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 3250 - Persuasion and Attitude Change

Human beings develop attitudes as a result of experience. Attitudes shape future behavior and impact perception. This course will explore how attitudes are identified, categorized and measured, and will examine many of the variables associated with changing established attitudes.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand

Pre-Requisite(s): PSY 2000

PSY 3300 - Psychology of Deviance

This course will guide the student through a scholarly study from how deviance is defined to an in-depth analysis of the numerous theories that seek to explain why individuals commit deviant acts.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2015-2016 academic year

Pre-Requisite(s): PSY 2000

PSY 3700 - Industrial Organizational Psychology

The psychology of work and organizations. Introduction to the use and application of psychology in the workplace. Focus is on the development of employees and organizational structure, and social behavior including the management of work groups and organizations.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2012-2013 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): PSY 2000

PSY 3720 - Social Psychology

Survey of social, cultural, and cognitive influences on individual and group behavior. Introduces attitude formation, social conformity, personal perception, aggression, cooperation, and interpersonal and intergroup relations.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring, Summer

Pre-Requisite(s): PSY 2000 and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

PSY 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: Spring - Offered alternate years beginning with the 2015-2016 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): PSY 2000

PSY 3860 - Human Performance

An overview of the psychology of human performance, including topics of movement, attention, perception, speech, expertise, and performance enhancement and degradation.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Class(es): Sophomore, Junior, Senior

Pre-Requisite(s): PSY 2000

PSY 4010 - Cognitive Psychology

Through lecture, demonstrations, and participation in classic cognitive experiments, this course provides a survey of topics in human cognition, including perception, attention, mental representation and processing, the architecture of memory, knowledge, visual imagery, problem solving, reasoning, and decision making.

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 4015 - Cognitive Task Analysis Methods

Cognitive task analysis (CTA) is a cognitive-systems engineering method to unpack complex cognitive work. The results support design requirements for new systems, strategies, or training. Students will practice collecting and analyzing CTA data using several methods.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2017-2018 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): 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

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): PSY 3060

PSY 4080 - Topics in Psychology

An examination of a specific area or approach within the field of Psychology.

Credits: variable to 4.0; May be repeated

Semesters Offered: On Demand

Pre-Requisite(s): PSY 2000

PSY 4090 - Independent Study in Psychology

Designed to allow students to participate in independent readings or research in a variety of areas within psychology.

Credits: variable to 6.0; Repeatable to a Max of 9

Semesters Offered: On Demand

Restrictions: Permission of instructor required; Must be enrolled in one of the following Major(s): Psychology; May not be enrolled in one of the following Class(es): Freshman, Sophomore

Pre-Requisite(s): PSY 2000

PSY 4095 - Field Experience in Psychology

Firsthand experience with the application of psychological principles in the field through volunteer placement with a community agency or business. Students are responsible for obtaining field placement site in coordination with instructor.

Students complete a comprehensive paper.

Credits: variable to 3.0; Repeatable to a Max of 6; Graded Pass/Fail Only

Semesters Offered: Fall, Spring, 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: On Demand

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): PSY 2000

PSY 4160 - Sensation and Perception

Examination of basic sensory mechanisms and perceptual phenomena. Sensory mechanisms reviewed will include vision, audition, olfaction, gustation, vestibular system and touch.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): 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: On Demand

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): PSY 2000

PSY 4400 - Tests and Measurements

Review of psychological tests and test theory, along with principles of construction and analysis of psychological tests.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Major(s): Psychology; May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): PSY 2720 or MA 2720

PSY 4500 - Senior Seminar: Psychology Capstone

Focusing on application to graduate programs, an intensive exploration into an area (e.g., experimental, developmental, clinical) of psychology or related field, will enhance learning and synthesize career goals in an effort to transition to an advanced educational program.

Credits: 1.0; Graded Pass/Fail Only

Lec-Rec-Lab: (0-1-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Major(s): Psychology; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

Pre-Requisite(s): PSY 3000(C)

PSY 4750 - Judgment and Decision Making

How can we make better decisions? Using examples from medicine, politics, law, business, and daily life, we review "descriptive" (psychological), "normative" (rational), and "prescriptive" (decision-engineering) theory. Topics include judgment, cognition, emotion, risk, uncertainty, heuristics, biases, and applications.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2018-2019 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): PSY 2720 or MA 2720

PSY 4870 - Human-Centered Design

This course will focus on the human-system (computers, appliances, mobile devices, etc.) Interaction regarding the design and development of products. Students will experience hands-on HCI activities (analysis-design-evaluation) and practice research methods based on HIC theory and perspectives.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2018-2019 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Sciences and Arts

SA 1000 - Exploring Majors at Michigan Tech

Exploration of majors and related career opportunities. Includes an introduction to University resources such as the Career Center, presentations by students in various majors, an examination of individual interests and abilities, opportunities for discussion and reflection, and guidance in choice of appropriate courses.

Credits: 1.0

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring

Systems Administration Technology

SAT 1200 - Introduction to Programming

Introductory course in C/C++ programming. Topics include top-down analysis of problems, structured programming, control statements, loops, and functions, arrays, and pointers. Basic concepts of object-oriented programming (classes, objects, function overloading) will also be introduced.

Credits: 3.0

Lec-Rec-Lab: (0-2-2)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Major(s): Industrial Technology, Computer Network & System 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

Pre-Requisite(s): SAT 1200 or CS 1111

SAT 1700 - Cyber Ethics

Ethics, morality, and privacy issues when working with technology. Topics include: foundational and professional issues in cyber ethics; privacy, security, and crime in cyberspace; intellectual property and internet regulation; the digital divide and online communities; and emerging and converging technologies.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Major(s): Computer Network & System 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, Summer

Pre-Requisite(s): SAT 1610

SAT 2511 - Microsoft System Administration

Microsoft server installation and configuration in an enterprise environment. Topics include: planning for server deployment and management; monitoring and maintaining servers; planning application and data provisioning; and planning for business continuity and high availability.

Credits: 4.0

Lec-Rec-Lab: (0-3-2)

Semesters Offered: Spring, Summer

Pre-Requisite(s): SAT 2343

SAT 2711 - Linux System Administration

Linux system installation and configuration in an enterprise environment. Topics include: Linux system architecture; Linux installation and package management; GNU and UNIX Commands; Linux file systems; hierarchy standards; shells, scripting and data management; user interfaces and desktops; administrative tasks; essential system services; and networking fundamentals and security.

Credits: 4.0

Lec-Rec-Lab: (0-3-3)

Semesters Offered: Fall, Summer

Pre-Requisite(s): SAT 1200 or CS 1111(C) or CS 1121 or CS 1131 or CS 1142 or MIS 2100

SAT 3002 - Application Programming Introduction

Students will develop problem solving skills through the application of a commonly used high-level programming language. Topics include: nature of the programming environment; fundamentals of programming languages; structured programming concepts; object-oriented programming concepts; desirable programming practices and design; and debugging and testing techniques.

Credits: 3.0

Lec-Rec-Lab: (0-2-1)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior

SAT 3200 - Storage Area Networking

Study of distributed network storage methods that include iSCSI, DAS, NAS, and SAN technologies. Other topics include configuration management, storage farms, backup, and recovery.

Credits: 3.0

Lec-Rec-Lab: (0-2-2)

Semesters Offered: Fall, Spring

Pre-Requisite(s): SAT 2511 and SAT 2711

SAT 3210 - Database Management

Introductory course on database management. Topics include data modeling, database design, implementation techniques, 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; Must be enrolled in one of the following Class(es): Junior, Senior

Pre-Requisite(s): SAT 1200 or CS 1111 or CS 1121 or CS 1131 or CS 1142 or MIS 2100

SAT 3310 - Scripting for Administration and Automation

Scripting in PERL, Python, BASH, and Powershell to accomplish and automate common system administration tasks such as working with files, network and web communication, and database interaction.

Credits: 3.0

Lec-Rec-Lab: (0-2-2)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Class(es): Sophomore, Junior, Senior

Pre-Requisite(s): SAT 1200 or CS 1111 or CS 1121 or CS 1131 or CS 1142 or MIS 2100

SAT 3343 - Network Administration II

Study of network devices in various architectures. Topics include routing protocols, TCP/IP, access-lists, remote network structures, network topologies, telnet and SSH authentication, switch programming, VLAN and STP configuration, IP traffic control, network troubleshooting and WAN encapsulation.

Credits: 4.0

Lec-Rec-Lab: (0-3-2)

Semesters Offered: Spring

Pre-Requisite(s): SAT 2343 or CS 3411

SAT 3611 - Infrastructure Service Administration

Administering Linux and Microsoft servers together to provide infrastructure services to mixed clients. Topics include: DNS; DHCP; file, web, mail, and directory services; and best practices for combining and mixing server platforms in an enterprise environment.

Credits: 3.0

Lec-Rec-Lab: (0-2-2)

Semesters Offered: Fall, Summer

Pre-Requisite(s): SAT 2511 and SAT 2711

SAT 3812 - Cyber Security I

The evolution of information security into cybersecurity and its relationship to nations, organizations, society, and individuals. Exposure to multiple cybersecurity technologies, processes, and procedures; analyzing threats, vulnerabilities and risks present; and developing appropriate strategies to mitigate potential cybersecurity issues. Applied lab to develop cyber security offensive attributes and learn how to prevent and/or mitigate threats.

Credits: 3.0

Lec-Rec-Lab: (0-2-2)

Semesters Offered: Fall, Summer

Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior
Pre-Requisite(s): SAT 1200 or CS 1111 or CS 1121 or CS 1131 or CS 1142 or MIS 2100

SAT 3820 - Wireless System Administration

Study of wireless communications, standards, and regulations in an enterprise environment. Topics include: various radio frequency and light communications; IEEE 802.11 Regulations and Standards; protocols and devices; network implementation; network security; and site surveying.

Credits: 4.0

Lec-Rec-Lab: (0-3-2)

Semesters Offered: Spring, Summer

Restrictions: Must be enrolled in one of the following Major(s): Computer Network & System Admn; Must be enrolled in one of the following Class(es): Junior, Senior

Pre-Requisite(s): SAT 1200 or CS 1111 or CS 1121 or CS 1131 or CS 1142 or MIS 2100

SAT 3900 - New Technologies Seminar

Offered first half of semester, to be taken concurrently with SAT3901. Weekly seminar series in which speakers from industry, universities, and government discuss current developments in networking and computer technology. The emphasis is on open research topics and questions that may lead to collaborative work with faculty and graduate students.

Credits: 1.0; Repeatable to a Max of 6; Graded Pass/Fail Only

Lec-Rec-Lab: (0-2-0)

Semesters Offered: Fall

Co-Requisite(s): SAT 3901

SAT 3901 - Becoming Human - Communication and Technical Improv Seminar

Offered second half of semester, to be taken concurrently with SAT3900. Weekly seminar series aimed at developing leadership qualities, soft skills, public speaking, and reactionary skills for students in technical fields. A fun and safe environment to develop and improve communication skills through situation and scenario-based exercises that include team building and games.

Credits: 1.0; Graded Pass/Fail Only

Lec-Rec-Lab: (0-2-0)

Semesters Offered: Fall

Co-Requisite(s): SAT 3900

SAT 4240 - Voice over IP Engineering

Voice over IP (VoIP) engineering and design. Topics include call and session protocols such as SIP, H.323, IAX and MGCP; VAD and PLC; common practical issues such as call redirection; codec integration and quality of service measurements.

Credits: 3.0

Lec-Rec-Lab: (0-2-2)

Semesters Offered: On Demand - 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 Scripting). Other topics include language syntax data and file structures, input/output devices, file, database access, and graphical user interfaces.

Credits: 3.0

Lec-Rec-Lab: (0-2-2)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Major(s): Computer Network & System Admn

Pre-Requisite(s): SAT 3002 or SAT 3310

SAT 4343 - Network Engineering

Topics include router and switch flow control; VoIP, compression and load balancing; VPN networks involving MPLS, IPSEC and PPP; advanced access-list configuration; AAA; Kerberos; TACACS; firewalls; and configuration of advanced routing protocols.

Credits: 3.0

Lec-Rec-Lab: (0-2-2)

Semesters Offered: Spring - Offered alternate years beginning with the 2010-2011 academic year

Pre-Requisite(s): SAT 3343

SAT 4411 - Data Center Engineering

Data center and virtualization strategies and design for an enterprise environment. Topics include: data center planning; disaster recovery; virtualization methods; and cloud computing services to provide business continuity.

Credits: 3.0

Lec-Rec-Lab: (0-2-2)

Semesters Offered: Spring

Pre-Requisite(s): (SAT 3200 and SAT 3611) or (SAT 3511 and SAT 3711)

SAT 4422 - Clinical Applications

Introduces the concepts and processes of clinical applications. Critical insight into the medical field will be provided by blending both the clinical and medical informatics perspectives. Students will gain hands-on clinical application experiences within predefined clinical settings.

Credits: 3.0

Lec-Rec-Lab: (0-2-2)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Major(s): Biological Sciences, Computer Network & System Admn, Exercise Science, Medical Laboratory Science, Sports and Fitness Management, Biomedical Engineering, Pharmaceutical Chemistry; May not be enrolled in one of the following Class(es): Freshman, Sophomore

SAT 4424 - Population Health Management

Introduces the concepts and processes of population health management with a special emphasis on clinical care coordination and case management assessment. Students will gain hands-on experience working on case management teams through MICARE and participating local healthcare organizations.

Credits: 3.0

Lec-Rec-Lab: (0-2-2)

Semesters Offered: Spring

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

Pre-Requisite(s): SAT 4422 or BL 2010 or BL 3080 or EH 1500 or KIP 1500 or SAT 5121

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: Must be enrolled in one of the following Major(s): Computer Network & System Admn; Must be enrolled in one of the following Class(es): Senior

Pre-Requisite(s): SAT 3812(C)

SAT 4600 - Web Application Development

An introduction to the building and administration of web applications. Topics covered include: Apache web server development; Tomcat application server; HTML; cascading style sheets; JavaScript; JQuery; server side includes; server side application development; web services; SSL/TLS; and authentication/authorization.

Credits: 3.0

Lec-Rec-Lab: (0-2-2)

Semesters Offered: Spring

Pre-Requisite(s): SAT 3002 or SAT 3310

SAT 4812 - Cyber Security II

An advanced course in cyber security that covers information assurance, cryptography and data security, and malware analysis. Key topics include: buffer overflow; security audits; cryptographic systems (symmetric and public-key algorithms); public-key certificates (X.509); message authentication; Kerberos; authentication applications; electronic mail security; IP security; and SELinux.

Credits: 3.0

Lec-Rec-Lab: (0-2-2)

Semesters Offered: Spring

Pre-Requisite(s): SAT 3812

SAT 4816 - Digital Forensics

Introduction of the basic principles and technology of digital forensics, including acquisition, preservation, and recovery and investigation of the evidence stored in digital devices.

Credits: 3.0

Lec-Rec-Lab: (0-2-2)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Major(s): Computer Science, Computer Network & System Admn, Computer Engineering; Must be enrolled in one of the following Class(es): Junior, Senior

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: Must be enrolled in one of the following Major(s): Computer Network & System Admn; Must be enrolled in one of the following Class(es): Senior

Pre-Requisite(s): 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: 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 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

Restrictions: Must be enrolled in one of the following Major(s): History, Social Sciences, Anthropology

SS 1002 - Introduction to Law and the Legal Practice

An introduction to how one becomes an attorney, what it is like to be an attorney, and the career options available to attorneys.

Credits: 2.0

Lec-Rec-Lab: (2-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2015-2016 academic year

SS 2001 - Introduction to Social Science Research

Students are introduced to various social science research methods and design. Covers scientific reasoning, developing questions, sampling, ethics, and quantitative and qualitative data collection using experiments, content analysis, survey, interview, oral history, statistics, GIS, comparative analysis, and archaeology.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2017-2018 academic year

Pre-Requisite(s): UN 1025(C) and (SS 2100(C) or SS 2300(C) or SS 2400(C) or SS 2600(C) or SS 2700(C))

SS 2050 - Fundamentals of Geographic Information Systems and Technologies

Introduction to geospatial sciences and technologies that are widely used for mapping and analyzing geographic patterns of human activities. Students gain hands-on experience in data collection, spatial data editing, georeferencing, spatial analysis, cartography, and spatial problem solving.

Credits: 3.0

Lec-Rec-Lab: (1-0-2)

Semesters Offered: Fall

SS 2100 - Introduction to Cultural Anthropology

Introduction to the field of cultural anthropology with a focus on human diversity, patterns of culture and human organization, globalization, and social change.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

SS 2200 - Introduction to 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: Spring

SS 2210 - Evolution of Cities: Their origins, growth, and future

This introductory course will explore questions by examining the physical, social, and spatial systems that influence how and where we live, work, and play in the ever-changing industrial and post-industrial city.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2015-2016 academic year

SS 2300 - Environment and Society

Examines social approaches to understanding why environmental problems happen and how environmental problems are resolved. Includes concepts such as sustainability, market-based environmental policies, property systems, and environmental justice. Case studies may include biodiversity, deforestation, climate change, water quality, and toxics.

Credits: 3.0

Lec-Rec-Lab: (2-1-0)

Semesters Offered: Fall, Spring

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

SS 2500 - United States History to 1877

This broad historical survey will examine the social, political, and economic development of North America and the US from initial human settlement through the civil war.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2015-2016 academic year

SS 2501 - United States History Since 1877

This broad historical survey will examine important intellectual, political, and social changes and events in the United States over the course of the twentieth century and beyond, representing the perspective of a wide variety of diverse individuals and groups.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2016-2017 academic year

SS 2502 - European History to 1650

A survey of the history of Europe from the Archaic Greek period to 1650. Covers political, social, intellectual, religious, economic, and artistic developments of the European continent.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2019-2020 academic year

SS 2503 - European History Since 1650

A survey of the history of Europe from the mid-seventeenth century to the present. Covers political, social, intellectual, religious, economic, and artistic developments on the European continent.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2013-2014 academic year

SS 2504 - World History to 1500

An introduction to the basic themes and content of world history from antiquity to 1500 CE.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2016-2017 academic year

SS 2505 - World History Since 1500

Survey of world history from 1500 CE to the present. Traces the evolution of different societies from around the world, emphasizing exchanges, interactions, and conflicts that produced global change.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2015-2016 academic year

SS 2510 - Gender and the Past

This course has two main goals: to explore the relationship between gender in the past and present; and to evaluate the actual empirical evidence that speaks to people's gendered lives in many times and places.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2018-2019 academic year

Pre-Requisite(s): UN 1015

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 2601 - Politics and Contemporary Issues of the European Union

A general introduction to the politics and contemporary issues of the European Union (EU). The course will explore the evolution of the EU and its expanding role in the lives of the citizens of its member states.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand

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: Fall

SS 2635 - Comparative Politics

Study of the government and politics of non-U.S. countries. Covers parliamentary, authoritarian, and presidential systems. Some attention to politics of the European Union.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2016-2017 academic year

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, Spring

SS 3105 - Native American and Indigenous Communities

Exploration of contemporary Native American and Indigenous communities worldwide, using a cross-cultural and comparative approach, with some historical context. Topics examined include the legacy of settler colonialism, issues facing Indigenous communities today, and Indigenous renewal and resistance, with emphasis on Native North America.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2018-2019 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3110 - Food Systems & Sustainability

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: Spring

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3200 - Archaeology of the Modern World

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 2017-2018 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

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): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3215 - Archaeology Laboratory Practicum

This hands-on lab practicum course exposes students to various stages of artifact processing and analysis in archaeological research. Projects teach best practices for cleaning, identification, data analysis, report preparation, and curation, all undertaken within critical framework structured by professional ethics.

Credits: variable to 6.0; Repeatable to a Max of 12

Semesters Offered: On Demand

Restrictions: Permission of department required

SS 3221 - Archaeological Sciences

Introduction to the archaeological sciences, including geo/bioarchaeology and materials science. Course emphasizes connections between field and laboratory, and scientific and environmental perspectives on the world's peoples and cultures, both ancient and industrial.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2018-2019 academic year

Co-Requisite(s): SS 3222

SS 3222 - Archaeological Sciences Laboratory

Using hands-on exercises and project-based learning, labs include identification, analysis, and stabilization of metals, ceramics, and organics from archaeological contexts, and include elements of geo- and bioarchaeology, and materials science.

Credits: 1.0

Lec-Rec-Lab: (0-0-3)

Semesters Offered: Fall - Offered alternate years beginning with the 2018-2019 academic year

Co-Requisite(s): SS 3221

SS 3225 - Capitalism and the Modern World

This course explores from an anthropological perspective themes concerned with the increasing interconnectedness of world cultures and economies after 1400. Focusing on Western expansion and the establishment of global networks in the Modern Era and tracing the social, political, and economic interactions that have shaped our contemporary world.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2018-2019 academic year

Pre-Requisite(s): UN 1015 and (UN 1025)

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: Spring - Offered alternate years beginning with the 2019-2020 academic year

Pre-Requisite(s): SS 2200 and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3240 - Reading the Landscape: Anthropology, Geography, History

Landscape is a lens through which scholars study people, environment, and place. The concept transcends traditional disciplinary boundaries. Students will read and discuss different approaches to landscape, with special focus upon anthropological, geographic, and historical perspectives.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2019-2020 academic year

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3250 - Biological Anthropology

A human evolution course focusing upon a summary of general bio - anthropological principles of evolutionary change, the current fossil record evidencing human evolution, and the consequences of human evolutionary change for modern human variability, health, and behavior.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2007-2008 academic year

Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3260 - Latin American Cultural History

This course examines the diverse, but interconnected, cultures of Latin America. The class will examine the sources and patterns of particular cultural traditions, while at the same time understanding the trajectory of social, political, and economic transformations throughout the region.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2019-2020 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3270 - Archaeology of the African Diaspora

Forced into slavery, the 'scatterlings' of Africa adapted and struggled to thrive in the New World. Archaeologists studying the Diaspora generally examine: 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 2019-2020 academic year

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3300 - Environmental Problems

An examination of local, regional, and global contemporary environmental problems. Critical consideration of underlying social, historical, and economic causes. Case studies drawn from topics such as global warming, ozone depletion, groundwater pollution, solid waste disposal, deforestation, and resource depletion. Studies proposed solutions and their impacts.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2017-2018 academic year

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3313 - Sustainability Science

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: Fall

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3315 - Population and Environment

This course investigates relationships between the world's population, population change, population distribution, resource consumption, and environmental and social consequences. Addresses local and global relationships and the population processes (mortality, fertility, and migration) involved.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2019-2020 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): (MA 1030 and MA 1031) or MA 1032 and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3400 - Contemporary Europe

Examination of the landscapes and cultures of modern Europe. Emphasizes cultural patterns and diversity, environmental quality, economic development, and forces of economic and political unification. Examines urbanization, industry, population, nationalism, and political change through regional examples.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3410 - World Resources & Development

Examination of the human geography and resources of various world regions. Emphasizes factors affecting prospects for development, including population dynamics, natural resource endowment, social and cultural systems, and spatial structure of society. Case studies of individual countries supplement general concepts and theories.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3500 - Modern American History

Surveys American history since 1945 using popular literature and film as a window onto social, economic, and political change.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3505 - Military History of the U.S.

History of the American military and its place in American society in both peace and war from the colonial period until the present.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3510 - History of American Technology

Survey of the technological changes that transformed a rural, agrarian America into an urban, industrialized nation. Focuses on how America's social values and geographical situation influenced the direction taken by its technology and engineering community and how America's industrialization, in turn, had significant effects on American society.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2016-2017 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3511 - History of Science in America

Examines the development of scientific enterprises in the U.S. from the colonial period through the present day. Emphasizes institutional bases of science and the place of scientific activities within American society.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 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: On Demand

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3513 - History of Making Things: Craft and Industry in America

Examines historical relationships between skill, tool use, embodied knowledge, and the design process in America from the colonial era to today. Includes production techniques, distribution systems, technological changes, industrialization, post-war globalization, and current craft and design.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2016-2017 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 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 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3520 - U.S. Environmental History

Examines how human interaction with physical environment has changed in North America over the last four centuries. Topics include uses of land by Native Americans, changes associated with European colonization, incorporation of natural resources into industrial economy, early conservation and preservation movements, and environmental concerns accompanying urbanization and industrialization.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3521 - Energy in American History

Examines changes in energy use throughout American history, beginning with energy use by American Indians and Europeans during colonial settlement and continuing through fossil fuels and adoption of nuclear power. Helps students see energy in all we do.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand

SS 3530 - The Automobile in America

Examines the automobile in diverse ways, seeing it as a complex product to be manufactured, as a stimulus to reshaping the environment, as an object that has altered social behavior, and as a problem solver and problem maker.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3540 - History of Michigan

The history of Michigan from before European settlement to the present.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3541 - The Copper Country

Examines the social, labor, and technological history of the Copper Country from the frontier era until the shutdown of the mines.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3552 - Renaissance & Reformation

The history of Europe from 1300 to 1650.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2015-2016 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3553 - Empires in World History

This course examines the social, political, cultural, economic, and geographical dimensions of imperialism. Students will research ancient and modern empires, with an emphasis on the long-run effects of the emergence, evolution, and collapse of empires.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2016-2017 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3560 - History of England I

The social, economic, and political history of England from Stonehenge to 1750.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2018-2019 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3561 - History of England II

History of England from 1750 to the present, including political, social, and economic developments in the period of Britain's greatest influence in the world.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2018-2019 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 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

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3580 - Technology and Western Civilization

An overview of the evolution of technology in Western civilization from classical antiquity to mid-twentieth century. In addition, the course looks at ways technology influenced development of Western civilization and ways values of Western civilization have conditioned Western technology.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3581 - History of Science

A survey of the development of scientific ideas (abstractions about how nature is and behaves) from the Greeks to the modern world, including major physical and life science revolutions by natural philosophers like Copernicus, Galileo, Darwin, and Einstein.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2014-2015 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

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: Spring - Offered alternate years beginning with the 2019-2020 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 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: Spring - Offered alternate years beginning with the 2017-2018 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3612 - International Relations

An introduction to the field and study of International Relations (IR). This course will cover major IR theories and current topics in global politics including: globalization, terrorism, human rights, and environmentalism.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2018-2019 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3621 - Introduction to Public Policy and Public Management

Key public policy and public management concepts are introduced and applied to the student's field of interest.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2017-2018 academic year

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3630 - Environmental Policy and Politics

A broad survey of how environmental policy making actually works in the U.S. Covers both environmental policy processes and politics, and the major environmental policies themselves for control of air pollution, water pollution, hazardous wastes, and other major environmental problems.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2019-2020 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3636 - Perceptions of The Modern State and Governance

Classic and contemporary theories of the state and approaches to governance are examined.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2017-2018 academic year

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3640 - Selected Topics in Cyber-Law

Applies legal and ethical principles to evolving computer technology. Explores current legal issues such as surveillance, privacy, free speech, crime, encryption, on line contracting, intellectual property and censorship, as well as legislative efforts to resolve these and other computing dilemmas.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2015-2016 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3650 - Intellectual Property Management

Covers principles of intellectual property law, addressing managerial and policy issues in copyright, trademark, trade secret, and patents. Readings and discussions also cover how these property and legal systems impact the balance between property exclusivity, technological innovation, and public access.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2016-2017 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3660 - Constitutional Law

Introduces the U.S. Constitution and how it has been interpreted by the Supreme Court over time. Explores historical, social and political consequences of major constitutional themes such as federalism, judicial review, and evolving view of individual rights and liberties.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2017-2018 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3661 - Civil Rights & Civil Liberties

Seminar focused on the rights and liberties guaranteed by US Constitutional amendments. Students learn constitutional theory and interpretation on topics of privacy, speech, media, religion, criminal justice, and gender/ethnic equality. Constitutional Law I is not required.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2014-2015 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3665 - Crime, Incarceration, and Social Policy

Explores criminal and social justice policies including policing and control of crimes involving violence, drugs, sexual offenses, and terrorism. Sentencing, effects of mass incarceration, and inequalities based on race and class will also be examined in student writing and debate.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2016-2017 academic year

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

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: On Demand

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 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: Fall - Offered alternate years beginning with the 2017-2018 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3760 - Human Dimensions of Natural Resources

Uses sociological concepts to cover facets of human relationships to natural resources, including human values, beliefs, and attitudes regarding the environment; rural resource-dependent communities; natural resource professions and expert knowledge; and the history of American perspectives on the environment.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3800 - Energy Policy and Technology

This course examines the policies and technologies affecting the production, transportation, and use of energy. It focuses on U.S. domestic energy policy and places it in the context of the global energy system. The course aims at providing a holistic view of energy systems connecting technological options with societal and environmental concerns.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2016-2017 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 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 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3805 - Environmental Justice

This course focuses on the histories, theories, and practices of environmental justice in local, national, and global contexts. Topics to be explored include environmental racism, industrial facility siting, sustainable development, as well as food, energy, and climate justice.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2018-2019 academic year

Pre-Requisite(s): UN 1015 and (UN 1025)

SS 3811 - Energy Security and Justice

This course focuses on concepts that are fundamental to energy policy: energy security and energy justice. It introduces students to the three main views of energy security (supply, demand, and energy services). In addition, the course provides a critical perspective of evaluating energy decision-making through the lenses of justice.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2017-2018 academic year

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3815 - Energy and Society

This course reviews extent that our lives are integrated with energy production and consumption, and related problems and solutions in our intertwined energy and social systems.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3910 - Histories and Cultures

Covers selected topics in world history, geography, or anthropology. Important concepts are the relationship between societies and regional geography, the sources and patterns of major cultures, and transformations of social, cultural, political, and economic institutions over time. May be repeated if topic differs.

Credits: 3.0; Repeatable to a Max of 9

Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3920 - Topics in Anthropology/Archaeology

Survey of a major branch of American anthropology or archaeology, or a specific time period or region. Topics may include North American prehistory, experimental archaeology, applied anthropology, economic anthropology, or other specialized themes. Readings will emphasize both theoretical and substantive contributions. May be repeated if 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) and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

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

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3951 - Topics in European History

Examines important themes, topics, or eras in European history, from late Antiquity to the present. Topics may include intellectual history, revolutions, monarchy, military history (incl. the Crusades), or migrations. May be repeated if topic differs. See department for current offering.

Credits: 3.0; Repeatable to a Max of 6

Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3952 - Topics in World History

Examines major ideas, processes, and events in world history. Topics may include trade and commodities, imperialism, slavery, migration, or other subjects with transnational significance. May be repeated if topic differs

Credits: 3.0; Repeatable to a Max of 6

Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3960 - Cultural Immersion

Course designed for students on supervised study abroad or exchange programs in which they investigate and report on cultural patterns and behaviors.

Credits: variable to 3.0; Repeatable to a Max of 9

Semesters Offered: Summer

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 3961 - Preparing for Cross-Cultural Immersion Experiences

Preparation for study abroad, service learning, and cross-cultural research or internships. Students reflect on their cultures; explore how to live and work effectively with other cultural groups, discuss cross-cultural professional ethics; and consider holistic approaches to social problems and change.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

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

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 4000 - Independent Study

Independent study of 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: Fall - Offered alternate years beginning with the 2016-2017 academic year

Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 4009 - Introduction to Survey Methodology

A general introduction to survey methods. Students will learn the basics of survey design from questionnaire construction to the measurement of complex social science concepts. Students will also demonstrate their ability to conduct an original survey through a class project.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2018-2019 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

SS 4010 - Statistics for the Social Sciences

Covers basic concepts and methods used in conducting empirical research in the social sciences. Topics include research design, hypothesis testing, measurement of concepts, and computer-based data analysis. Assumes familiarity with Social Sciences concepts.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2019-2020 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): PSY 2720 or MA 2720 or BUS 2100

SS 4020 - Methods of Teaching Social Studies

Application of learning and instructional theories and practice to the teaching of social studies. Emphasis will include application of state and national education standards and relevant assessment strategies for social studies. Requires admission in the Teacher Education program by the Department of Education.

Credits: 2.0

Lec-Rec-Lab: (0-2-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2017-2018 academic year

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 - Advanced Research 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: Spring

Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior

SS 4050 - Advanced GIS Methods and Projects

Advanced application of Geographic Information Systems in social sciences as a tool to collect and analyze qualitative and quantitative data. Students gain hands-on experience in data collection, advanced spatial analysis, and scripting.

Credits: 3.0

Lec-Rec-Lab: (1-0-2)

Semesters Offered: Fall - Offered alternate years beginning with the 2019-2020 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): SS 2050 and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 4120 - Anthropology of International Development

Advanced anthropology course that focuses on cultural, social structural, historical, and environmental analyses of international development. Students engage with relevant social theory and practical applications in international development case studies.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

Pre-Requisite(s): UN 1015 and (UN 1025)

SS 4200 - Environmental Anthropology

A seminar on the study of culture and politics in marginal environments and disadvantaged communities. Draws upon research in anthropology and geography to examine the interaction in the Americas, Asia, Africa, Europe, the Pacific, and the Arctic.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2019-2020 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): SS 2100 and UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 4205 - Applied Anthropology

Course examines the ways anthropology is used outside of an academic context. Students study how anthropological theory and methods are used in a variety of contexts and how they benefit society. This course also emphasizes the impact of applied anthropology on the development of American anthropology as a whole, and how it has advanced our theoretical knowledge of culture and human behavior.

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

SS 4211 - Ethnographic Methods

Field-based course that surveys basic concepts of ethnography and applies them in a class research project. Provides practical experience in field observation, interviews, field notes, and write-up of research.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

Pre-Requisite(s): UN 1015

SS 4220 - Archaeological Thought in Society

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 4230 - Archaeological Analysis and Interpretation

Course focuses on how archaeologists mobilize material data to understand everyday life in the past. Discussion, exercises, and lab time are used to cover the goals of archaeology, nature of archaeological data, research design, sampling, typology, classification, database management, and quantitative and qualitative analytical methods.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand - Offered alternate years beginning with the 2017-2018 academic year

Pre-Requisite(s): SS 2200

SS 4325 - Water Policy, History, and Governance

This course will explore the global history, politics, and governance of freshwater resources. Topics will include the effects of forestry, mining, watershed management, sanitation systems, climate change, fisheries, contaminants, and agriculture on water history, governance, and policies.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2018-2019 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

Pre-Requisite(s): SS 3520

SS 4380 - Landscape Ecology and Planning

Basic principles of landscape ecology, including pattern, process, and scale. Students will learn how to use quantitative tools to study landscape-scale patterns and processes, and how to apply these principles and tools to conservation, resource management, and planning issues.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring

Restrictions: May not be enrolled in one of the following Class(es): Freshman

SS 4390 - Seminar in Sustainability

This seminar in sustainability topics will cover a rotating set of topics, depending on semester offering. Topics may include energy use, justice, pollution, green design, or regulations bearing on sustainability.

Credits: 3.0; Repeatable to a Max of 9

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

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 - Offered alternate years beginning with the 2015-2016 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman

SS 4501 - Senior Thesis

Directed study leading to production of a senior thesis for all social science majors.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Major(s): Liberal Arts with History Opt; Must be enrolled in one of the following Class(es): Junior, Senior

Pre-Requisite(s): SS 4500(C)

SS 4502 - Historical Research

This course supports historical research in conjunction with any upper-division history seminar. Students must take both courses simultaneously, and will work directly with the instructor to produce an original research paper.

Credits: 1.0; May be repeated

Lec-Rec-Lab: (0-1-0)

Semesters Offered: On Demand

Restrictions: Permission of instructor required; May not be enrolled in one of the following Class(es): Freshman

SS 4530 - Deindustrialization and the Urban Environment

This course examines economic, environmental, and social problems associated with deindustrialization in postwar North American cities and the strategies adopted to ameliorate them. Major topics include segregation and housing, environmental regulation, environmental justice, industrial heritage, and economic and urban development policy.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2018-2019 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

Pre-Requisite(s): UN 1015 and (UN 1025)

SS 4540 - Global Environmental History

This course explores changes in human interactions with earth systems over time, starting with the development of agriculture and continuing to the present. Case studies include mining, forestry, water, agricultural, sustainability, and urban development.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2019-2020 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

Pre-Requisite(s): SS 3520

SS 4550 - History of Technology

Advanced reading and discussion course focusing on the various ways in which we understand writing about the history of technology. This course provides the theoretical framework for research and writing in the field, and culminates in a major research project with primary source research as well as a required interpretive component.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2019-2020 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

Pre-Requisite(s): (SS 2500 or SS 2501 or SS 2502 or SS 2503 or SS 3510 or SS 3580) and UN 1015 and (UN 1025)

SS 4551 - Industrial Communities

Introduces advanced students to scholarly literature on industrial communities and company towns. Focus will be in North America, but also includes cases in Latin America, Europe, Africa, and Asia. Students will acquire skills in oral history, work with archival materials, and conduct field-based research.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2019-2020 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

SS 4552 - Historical Archaeology

This course examines the relevance of archaeology and the varied approaches archaeologists use in examining our Modern World. How do archaeologists interpret the archaeological record and how do archaeological perspectives affect the questions, interpretations, and meanings we bring to understanding the past, the present, and the future.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2019-2020 academic year

Pre-Requisite(s): UN 1015 and (UN 1025)

SS 4553 - Material Culture Studies

Advanced reading and research in material culture studies. Learn to interpret the cultural and historical meanings in physical objects such as tools, housewares, memorials, furniture, etc. Emphasis on American craft, industry, and deindustrialization. Methodologies from archaeology, American studies, museum studies, public history, art history, etc.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2019-2020 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): SS 3513 and UN 1015 and (UN 1025)

SS 4600 - Industrial Archaeology

This course is an advanced exploration of the industrial past using archaeological perspectives. It is a seminar combining scholarship from different fields and using material evidence to examine the evolution of work and production in industrial society.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2018-2019 academic year

Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior

Pre-Requisite(s): SS 2200 or SS 3200 or SS 3230 or SS 3270

SS 4630 - Advanced Research in the Social Sciences

Capstone course for students to develop an original social science thesis research project in the areas of Politics, Law, Sociology, or Sustainability. Students will prepare a proposal for a senior research project.

Credits: 2.0

Lec-Rec-Lab: (0-2-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior

SS 4700 - Communities and Research

A rural sociology course analyzing the sustainability of rural communities (socially, environmentally, economically, and culturally). The course involves participatory research conducted together with a local community organization. Students practice research skills while making a difference in improving community life.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2016-2017 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

Pre-Requisite(s): UN 1015 and (UN 1025 or Modern Language - 3000 level or higher)

SS 4900 - Seminar in Social Sciences

An intensive seminar study of a topic of importance and special interest in the social sciences. Topics could focus on the history of anthropological theory or on world religious systems in comparison. May be repeated if topic differs.

Credits: variable to 3.0; Repeatable to a Max of 9

Semesters Offered: On Demand

Restrictions: May not be enrolled in one of the following Class(es): Freshman

SS 4910 - Professional Development for the Social Sciences

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: Spring

Restrictions: Must be enrolled in one of the following Major(s): History, Social Sciences, 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 Internship - 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: 3.0; Repeatable to a Max of 9

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Permission of department required

Pre-Requisite(s): UN 1015 and (UN 1025)

SS 4990 - Directed Study in Anthropology

An original study of an anthropological problem, including literature search, data collection, and analysis, culminating in a research report.

Credits: variable to 3.0

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Class(es): Senior

Surveying**SU 1000 - Surveying Engineering Orientation**

Introduction to the surveying engineering profession with emphasis on technology and careers. Topics include: technology, specialties, education, professional practice, life-long learning, and ethics related to surveying engineering.

Credits: 1.0

Lec-Rec-Lab: (0-1-0)

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 or SU 2000

SU 3110 - Surveying Field Practice

Survey projects from field to finish using current surveying equipment and software. Basic statutes and ethics governing the practice of surveying. Projects cover level networks, horizontal control, design surveys, construction layout, section subdivision, map and report preparation.

Credits: 4.0

Lec-Rec-Lab: (0-2-6)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior

Pre-Requisite(s): SU 2220

SU 3180 - Boundary Surveying Principles

Interpretation of property descriptions used to establish land boundaries. Resolving conflicts in boundary descriptions as well as conflicts in evidence. Review doctrines pertaining to transferring title and the role of the surveyor in issuing opinions on boundary location in boundary disputes.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior

Pre-Requisite(s): SU 3600(C)

SU 3210 - Site Planning and Development

An examination of land development issues including: site analysis, environmental concerns, contouring, earthwork and grading, soils, route alignments, storm water management, sewer systems, zoning, and land planning. Incorporates CAD applications in the lab.

Credits: 4.0

Lec-Rec-Lab: (0-3-2)

Semesters Offered: Spring

Restrictions: May not be enrolled in one of the following Class(es): Freshman

Pre-Requisite(s): SU 2000

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: (0-3-2)

Semesters Offered: Spring

Pre-Requisite(s): MA 3710

SU 3600 - Surveying Computations and Adjustments

Basic computations and analysis of surveying measurements by adjustment theory are introduced. Students will gain the ability to use computer software to perform the computations. Analysis of measurements and errors based on statistical principles and least squares principles will be discussed.

Credits: 4.0

Lec-Rec-Lab: (0-3-2)

Semesters Offered: Fall

Pre-Requisite(s): (SU 2000 or SU 2050) and (MA 2320 or MA 2321 or MA 2330) and SU 3110(C) and MA 3160(C) and MA 3710(C)

SU 4010 - Geospatial Concepts, Technologies, and Data

High level review of geospatial data acquisition systems, sensors, and associated processing technologies. Course considers geospatial metadata generation principles, interoperability, and major tools for manipulation with geospatial data. Course may help in transition of non-geospatial majors to geospatial field.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Permission of instructor required

SU 4045 - Geospatial Data Fusion

Fundamentals of GIS data, aerial photographs, satellite imagery, airborne/terrestrial laser scanning data. Characteristics of remotely sensed data including information specific to the sensors used to obtain it. Term project on how to combine and fuse to a specific application.

Credits: 3.0

Lec-Rec-Lab: (0-2-1)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Class(es): Senior

Pre-Requisite(s): SU 4140

SU 4060 - Geodesy

Concepts of astronomy and geodesy that are relevant to the practice of surveying. Covers theory, field techniques, and computations involved in the determination of true north, an introduction to the figure of the earth and its geometric and physical characteristics, geodetic datums, and coordinate systems.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Major(s): Surveying Engineering; Must be enrolled in one of the following Class(es): Senior

Pre-Requisite(s): SU 3600(C) or SU 3250

SU 4100 - Geodetic Positioning

Introduces the instruments and procedures used in surveying projects that require a high order of accuracy. Discusses some conventional instruments and techniques but the greater emphasis is on GPS techniques.

Credits: 3.0

Lec-Rec-Lab: (0-2-3)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior

Pre-Requisite(s): SU 4060(C)

SU 4140 - Photogrammetry

Basic principles of photogrammetry and its role as a technology for spatial data collection. Use of photogrammetry in the fields of surveying, engineering, and geographic information management will be discussed.

Credits: 3.0

Lec-Rec-Lab: (0-2-2)

Semesters Offered: Fall, Spring

SU 4142 - 3D Surveying and Modeling with Laser Scanner Data

Theory and application of terrestrial LIDAR scanning. Typical application scenarios are also included. Intensive lab component provides hands-on experience in LIDAR point cloud processing and visualization.

Credits: 3.0

Lec-Rec-Lab: (0-2-1)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Class(es): Senior

SU 4180 - Land Subdivision Design

Introduces the physical, economic, and social aspects of optimum land use within the framework of state and local regulations of land divisions, condominiums, mobile home parks, and residential subdivisions.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior

Pre-Requisite(s): SU 3180 and (CMG 3200 or SU 3210)

SU 4900 - Capstone Design Project

An engineering design project which integrates multiple aspects of previous surveying coursework while working with an industry partner. Includes project description, project planning, field work, office analysis, computer-aided design, final project completion and oral presentation skills.

Credits: 3.0

Lec-Rec-Lab: (0-2-3)

Semesters Offered: Fall, Spring

Restrictions: Permission of instructor required; Must be enrolled in one of the following Major(s): Surveying Engineering; Must be enrolled in one of the following Class(es): Senior

SU 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 the elements of the NCEES Fundamentals of Surveying examination, utilizing on-line quizzes, as well as administering the Michigan Tech Surveying Engineering Exit Exam. Course taken in final semester only.

Credits: 1.0; Graded Pass/Fail Only

Lec-Rec-Lab: (0-1-0)

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Class(es): Junior, Senior

Technology**TE 4996 - Special Topics in Technology**

Selected additional topics of interest in Technology based on student and faculty demand and interest. May be a tutorial, seminar, workshop, project, or class study.

Credits: variable to 3.0; Repeatable to a Max of 6

Semesters Offered: On Demand

Restrictions: Permission of instructor required; Must be enrolled in one of the following College(s): School of Technology; Must be enrolled in one of the following Class(es): Senior

TE 4997 - Independent Study in Technology

Independent study of an approved topic under the guidance of a School of Technology faculty member. May be either an academic, design, or research problem/project.

Credits: variable to 3.0; Repeatable to a Max of 6

Semesters Offered: On Demand

Restrictions: Permission of instructor required; Must be enrolled in one of the following College(s): School of Technology; Must be enrolled in one of the following Class(es): Senior

TE 4998 - Undergraduate Research in Technology

An undergraduate research experience in Technology. Under the guidance of a School of Technology faculty member, students work on a selected/approved research problem or work directly with faculty on active research projects/grants. May require more than one semester to complete.

Credits: variable to 6.0; Repeatable to a Max of 6

Semesters Offered: On Demand

Restrictions: Permission of instructor required; Must be enrolled in one of the following College(s): School of Technology; Must be enrolled in one of the following Class(es): Senior

University Wide

UN 1000 - Frameworks for Success for ExSEL

Course that explores ways to become a more effective student. The course focuses on metacognition and individual learning styles, the skills and habits that support academic success, and utilizing campus resources. Counts as a free elective.

Credits: 1.0

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring, Summer

UN 1005 - Initiatives for Success

Course that explores ways to become a more effective student. The course focuses on metacognition and individual learning styles, the skills and habits that support academic success, and utilizing campus resources. This course includes a mandatory learning center appointment assigned upon registration. Course counts as a free elective.

Credits: 1.0

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring, Summer

UN 1010 - Creating Your Success for Themed Communities

First year seminar course that develops community among members of residential themed communities and provides an introduction for creating academic, professional, and personal success. This course is required for all first-year and transfer (with less than 30 credits) students living in a residential themed community. Course counts as a free elective.

Credits: 1.0

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring, Summer

UN 1011 - Strategies for Success

Seminar course that provides a framework to assess the strategies a student is currently using to achieve academic, professional, and personal success. The course is designed to look at ways to improve upon a student's strategies for success or adopt new ones. This course is required for all first-year or transfer (with less than 30 credits) students who are on academic probation for the first time after fall or spring of their first year. This course is also available with permission from the Dean of Students, to any student who feels they would benefit from additional strategies for success. Course counts as a free elective.

Credits: 1.0

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring, Summer

UN 1012 - Academic Language & Practice

This course is designed for speakers of English as a second language admitted into academic study, not native speakers of English. It assesses language ability and focuses on academic language and practices.

Credits: 1.0; Graded Pass/Fail Only

Lec-Rec-Lab: (0-0-3)

Semesters Offered: Fall, Spring

UN 1015 - Composition

Provides direct instruction in composition. Students examine and interpret communication practices and apply what they learn to their own written, aural, and visual compositions. 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

UN 1025 - Global Issues

Study of contemporary global issues, their origins, impacts, and solutions through the thematic and comparative exploration of worldview and culture, population, globalization, development, politics and global governance, environment, and sustainability. Emphasis on global literacy and information literacy.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Class(es): Freshman

UN 2600 - Fundamentals of Nanoscale Science and Engineering

Team-taught introduction to the fundamentals of nanotechnology, emphasizing the interdisciplinary nature of this field. Modern instrumentation, key scientific foundations, and current and potential applications will be discussed. Real and potential societal implications of nanotechnology will be explored.

Credits: 2.0

Lec-Rec-Lab: (1-1-0)

Semesters Offered: Spring, Summer - Offered alternate years beginning with the 2007-2008 academic year

UN 3002 - Undergraduate Cooperative Education I

Credits may count as free or technical electives based on academic department. Requires good standing, registration with Career Services, and an official offer letter from the employer.

Credits: variable to 2.0; May be repeated

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of department required; May not be enrolled in one of the following Level(s): Graduate

UN 3003 - Undergraduate Cooperative Education II

Credits may count as free or technical electives based on academic department. Requires good standing, registration with Career Services, and an official offer letter from the employer.

Credits: variable to 2.0; May be repeated

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of department required; May not be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): UN 3002

UN 3004 - Undergraduate Cooperative Education III

Credits may count as free and technical electives based on academic department. Requires good standing, registration with Career Services, and an official offer letter from the employer.

Credits: variable to 2.0; May be repeated

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of department required; May not be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): UN 3002 and UN 3003

UN 3005 - Undergraduate Cooperative Education IV

Credits may count as free or technical electives based on academic department. Requires good standing, registration with Career Services, and an official offer letter from the employer.

Credits: variable to 2.0; May be repeated

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of department required; May not be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): UN 3002 and UN 3003 and UN 3004

UN 3990 - Special Topics - Interdisciplinary

Study of interdisciplinary special topics as specified by section title.

Credits: variable to 6.0; May be repeated

Semesters Offered: On Demand

Restrictions: Permission of instructor required

UN 4000 - Seminar Series in Earth, Planetary, and Space Sciences

A seminar series that covers topical issues in remote sensing, ecosystem research, global change, and space sciences.

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 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

Graduate Course Descriptions

Effective Fall 2019

Accounting

ACC 5000 - Accounting Foundations I

Introduction to basic theories, concepts, and practices to understand fundamental accounting principles and the resultant financial statements. Topics include the decisions-making environment, accounting cycle, financial measurement and reporting.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Summer

Restrictions: Permission of department required; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

ACC 5050 - Accounting Foundations II

Continuation of ACC5000 with theories, concepts, and practices underlying financial measurement and reporting. Topics include income measurement, cash flows, allocation of costs, budgeting, and decision making.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Summer

Restrictions: Permission of department required; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

ACC 5100 - Advanced Auditing and Fraud Examination

An in-depth study of auditing with a focus on fraud examination from an external auditor's perspective. The course utilizes problems, cases, and projects relating to fraud examination and forensic accounting.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Major(s): Accounting; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior
Pre-Requisite(s): ACC 4100

ACC 5200 - Financial Statement Analysis

Study of financial statement analysis and concepts of valuation utilizing accounting based financial information. Methods are applied to encompass decision making, communication, and judgment using problems, cases, and projects.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Accounting; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

ACC 5300 - Financial Reporting and Control

This class covers the collection, reporting, and analysis of financial information with emphasis on the use of that information to support decision making.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Accounting

ACC 5500 - Strategic Cost Accounting

This course focuses on the use of managerial accounting information in making strategic business decisions. Topics include contemporary costing methods, advanced capital budgeting, profit center analysis, transfer pricing, and performance evaluation.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Accounting; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

ACC 5600 - Taxation for Decision Makers

This course focuses on how taxes impact management decision making. Advanced tax planning techniques are studied to develop analytical, research, and professional communication skills.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Summer

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Accounting; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

ACC 5700 - Accounting Analytical Methods

Statistical analysis of large datasets. Computer programming will be used to analyze and manipulate the data. Topics include fundamental analysis, fraud detection, default prediction on loans, and other contemporary accounting issues.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Major(s): Accounting; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

ACC 5800 - Advanced Accounting Systems

This course presents a comprehensive understanding of accounting information systems and advanced technology in the accounting environment. It emphasizes how to use these tools to enhance financial decision making. Topics include contemporary technology and applications.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Major(s): Accounting; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior
Pre-Requisite(s): ACC 4800

ACC 5900 - Current Issues in Accounting

This course examines current issues in the accounting profession. Designed as a capstone course to further understand concepts introduced through the analysis of contemporary accounting issues.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Summer

Restrictions: Must be enrolled in one of the following Major(s): Accounting; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

ACC 5990 - Special Topics in Accounting

Accounting topics of interest to students. Study is under the guidance of a faculty member.

Credits: variable to 3.0; Repeatable to a Max of 6

Semesters Offered: On Demand

Restrictions: Permission of instructor required; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

Atmospheric Science

ATM 5100 - Atmospheric Sciences Research Discussion

A weekly discussion of recent literature in the atmospheric sciences. Often coordinated with atmosphere-related seminars in the Remote Sensing seminar series.

Credits: 1.0; May be repeated

Lec-Rec-Lab: (0-1-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2010-2011 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): ATM 5515(C) or ATM 5640(C) or ATM 5680(C) or ENVE 5515 or PH 5640 or PH 5680 or CEE 5515

ATM 5200 - Special Topics in Atmospheric Sciences

Advanced study of topics in the atmospheric sciences. The subject matter may vary from term to term depending on the needs and interests of students.

Credits: variable to 3.0; Repeatable to a Max of 9

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

ATM 5512 - Applied Boundary Layer Meteorology

Study of how forcing phenomena affect transport of water and chemicals in the atmospheric boundary layer and how this transport is measured in the field, including relevant aspects of fluid dynamics, boundary layer structure, surface energy balance, and flux measurement.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2014-2015 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

ATM 5515 - Atmospheric Chemistry

Study of the photochemical processes governing the composition of the troposphere and stratosphere, with application to air pollution and climate change. Covers radical chain reaction cycles, heterogeneous chemistry, atmospheric radiative transfer and measurement techniques for atmospheric gases.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): CH 3510 or CH 3520 or ENVE 4504 or CEE 4504

ATM 5516 - Aerosol and Cloud Chemistry

This course is focused on the chemistry of atmospheric aerosols and cloud processes. Students will learn about methods for chemical characterization, the chemical composition of aerosol and the chemical reactions pertinent to secondary aerosol and cloud composition.

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, Junior

Pre-Requisite(s): ATM 5515(C)

ATM 5519 - Atmospheric Biogeochemistry

Study of the relationship between atmospheric composition, global change, and the circulation of major elements through the Earth system. Responses of ecosystem emissions to changes in land use, biodiversity, nutrient supply, plant stressors, and climate change are discussed.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

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, Sophomore, Junior

Pre-Requisite(s): CH 1150

ATM 5640 - Atmospheric Physics

Essential elements of atmospheric physics, including thermodynamics (e.g. adiabatic processes, phase transformations, stratification), aerosol and cloud physics (e.g. nucleation, Kohler theory, growth by condensation and collection), and radiative transfer (e.g. Beer's law, transfer equations with and without scattering).

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2008-2009 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): MA 3530 and PH 2300

ATM 5680 - Geophysical Fluid Dynamics

Fundamentals forces and conservation laws that govern fluid flow; applications to the atmosphere and ocean, including balanced flow (pressure gradient and Coriolis Force), vorticity dynamics, turbulence, waves, and boundary layers.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2017-2018 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

Pre-Requisite(s): MA 3530 and PH 2300

ATM 6999 - Doctoral Research

Independent research conducted in partial fulfillment of the requirements of the Atmospheric Sciences doctoral degree.

Credits: variable to 12.0; May be repeated; Graded Pass/Fail Only

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

BA 5400 - Financial Risk Management and Decision Making

Explores the theory and practice of finance and capital markets. Topics include role of the financial manager and goals of the firm, financial mathematics, valuation of assets, cost of capital, project evaluation, capital structure, forecasting, financing vehicles, special topics in finance.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring, Summer

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Business Administration, Applied Natural Resource Econ., Accounting

Pre-Requisite(s): BA 5300

BA 5610 - Operations Management

Applications and case studies focusing on contemporary issues in operations and quality management to include lean manufacturing practices, ERP, quality and environmental management systems/standards, Six Sigma, statistical process control, and other current topics.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Data Science, Applied Natural Resource Econ., Accounting, Business Administration

Pre-Requisite(s): MA 2710 or MA 2720 or MA 3710 or EET 2010 or CEE 3710

BA 5650 - Project Management

Focuses on project definition, selection, planning, scheduling, implementation, performance monitoring, evaluation and control. Emphasis will be on product, service and process development and emerging concepts related to development on the internet. Some advanced concepts in resource constraint management and design matrix are included.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): MA 2710 or MA 2720 or MA 3710 or EET 2010 or CEE 3710 or BUS 2100

BA 5700 - Managing Behavior in Organizations

Discusses managing effectively within the environmental context of the organization. Topics include corporate culture, managing in a global environment, planning and strategy, organizational structure, human resources management, managing change, leadership, motivation, communication, conflict management, and teamwork.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Business Administration, Applied Natural Resource Econ., Accounting

BA 5710 - Business and Corporate Strategies

Introduces students to a repertoire of strategies that have been found useful in the creation of competitive advantage: cost leadership, business model differentiation, vertical integration, diversification, globalization, mergers and acquisitions, tacit collusion, alliance, and flexibility-agility-adaptability strategies.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Business Administration, Applied Natural Resource Econ., Accounting

Pre-Requisite(s): BA 5300 and BA 5400(C) and BA 5700 and BA 5800

BA 5720 - Launching Entrepreneurial Ventures

Focuses on the development of new technology-based businesses. Topics include creativity, screening technological opportunities, analyzing markets, testing business concepts, protecting intellectual property, strategy development, entrepreneurial team selection, securing financing, and developing a business plan.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Business Administration, Applied Natural Resource Econ., Accounting

BA 5740 - Managing Innovation and Technology

An evolutionary strategic perspective is taken viewing how technology strategy evolves from underlying technological competencies, patterns of innovation, sources of external technological knowledge and modes of transfer.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Data Science, Applied Natural Resource Econ., Accounting, Business Administration

Business Administration**BA 5200 - Information Systems Management and Data Analytics**

Focuses on management of IS/IT within the business environment. Topics include IT infrastructure and architecture, organizational impact of innovation, change management, human-machine interaction, and contemporary management issues involving data analytics. Class format includes lecture, group discussion, and integrative case studies.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Data Science, Applied Natural Resource Econ., Accounting, Business Administration

BA 5300 - Financial Reporting and Control

This class covers the collection, reporting, and analysis of financial information with emphasis on the use of that information to support decision making.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Business Administration, Applied Natural Resource Econ., Accounting

BA 5770 - Managing Change

This course focuses on theory, research, and practice of both 'planned' and 'unplanned' change. The course considers the dynamics of change in complex organizations, variables which facilitate or impede change, and how to lead change and motivate others to change.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Summer

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Business Administration, Applied Natural Resource Econ., Accounting

Pre-Requisite(s): BA 5700

BA 5780 - Managing in the Global Environment

Course topics may include the following: impact of international political, economic, technological, and social environment forces, currency risks, cross-cultural management issues, strategic challenges for multinational companies, and international joint ventures and alliances.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Summer

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Business Administration, Applied Natural Resource Econ., Accounting

Pre-Requisite(s): BA 5700 and BA 5400(C)

BA 5800 - Marketing, Technology, and Globalization

The course facilitates students' improvement of analytical skills, information processing techniques, and cultural competence in the globalized marketing environment. Focuses are placed on strategic marketing management, high-tech product marketing, global consumer behavior, branding, and online marketing.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Data Science, Applied Natural Resource Econ., Accounting, Business Administration

BA 5900 - MBA Internship

An opportunity to apply the business principles and skills learned in the MBA program to an organizational environment. The guided experience is integrated with coursework to achieve personalized learning objectives.

Credits: variable to 3.0; Repeatable to a Max of 3

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Applied Natural Resource Econ., Business Administration

BA 5990 - Special Topics

Business topics of interest to students. Study is under the guidance of a faculty member.

Credits: variable to 3.0; Repeatable to a Max of 6

Semesters Offered: On Demand

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Applied Natural Resource Econ., Business Administration

Biomedical Engineering**BE 5000 - Biomedical Masters Research**

Includes the study of an acceptable biomedical engineering problem and the preparation of a report or thesis.

Credits: variable to 12.0; May be repeated; Graded Pass/Fail Only

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Level(s): Graduate

BE 5115 - Finite Element Modeling

The course teaches both fundamentals of finite element theory and hands-on experience for bio-engineers.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

BE 5200 - Cellular and Molecular Biology II

Covers, at an advanced level, the general principles and engineering applications of science and biology, including cell biology, physiology, molecular biology, genetics, and biotechnology.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

BE 5230 - Stem Cell and Tissue Engineering

This course will introduce basic concepts of tissue engineering; scaffold materials and biotechnologies for tissue engineering; basic concept of stem cells; review of stem cell sources and related policies; current progress in stem cell research, and application of stem cells in tissue engineering and regenerative medicine.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

BE 5250 - Biomedical Optics

Light plays a significant role in modern clinical diagnostics and in the clinical treatment of disease. Examples include non-invasive surgery, optical biopsy, and cancer therapy. This course will focus on the study of how light propagates through biological tissue.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2014-2015 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

BE 5300 - Polymeric Biomaterials

A specialized study of polymers used in biomedical engineering. Topics include: processing-structure-properties relationships for polymers, polymer fibers and composites, degradation of polymers, and medical applications for composite biomaterials.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2009-2010 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

BE 5330 - Biomimetic Materials

This course introduces students to biologically inspired approaches to design functional biomaterials. Topics include the discovery and incorporation of biological designs into novel materials and their application in the biomedical field.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2014-2015 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

BE 5335 - Smart Polymers

This course introduces students to smart polymers that change their physical properties in response to various environmental stimuli. Topics include the molecular origin of the stimuli responsiveness of these materials and their application in the biomedical field.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2015-2016 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

BE 5350 - Cell Biomechanics and Mechanical Transduction

This course is designed to introduce the mechanical analysis and characterization of mammalian cells. Mechanotransduction, whereby cells detect loading and respond to the morphology and mechanical properties of the surrounding extracellular matrix, will be emphasized.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate

BE 5390 - Scientific Computing

Set in a Linux environment, course offers exposure to Foss tools for developing computational and visualization workflows. Students will learn to translate problems into programs, understand sources of errors, and debug, improve the performance of and parallelize the code.

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

BE 5410 - Medical Imaging

This course covers the physical nature of the interactions between the waves and matter, especially the biological tissues, principle imaging modalities used in modern medicine and the common techniques used for processing of the resulting images.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2018-2019 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

BE 5510 - Cardiovascular Engineering

Fundamental cardiovascular pathology and the biomedical engineering approaches being developed and used toward problems resulting in significant cardiovascular deficiency such as myocardial infarction, chronic kidney disease, atherosclerosis, and heart valve disease.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate

BE 5550 - Biostatistics for Health Science Research

An overview course of biostatistical methods used in the health sciences. Topics include a review of undergraduate statistical concepts, NIH, CDC, and FDA guidelines for clinical trial research, proper use of biostatistical methods including anova models, logistic regression, risk analysis, survivorship analysis and any other statistical methods that are common in the enrolled students' discipline.

Credits: variable to 4.0

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): MA 2720 or MA 3710

BE 5670 - Micro & Nano Technologies

This course will introduce students to micro- and nano- technologies and the processes involved in their manufacturing. Particular emphasis will be on their use in biomedical applications. Goal is to provide information beneficial in research and development, and the industry.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate

BE 5700 - Biosensors

This course introduces the student to the fundamentals of biosensor development and applications. It provides an understanding of biological components, immobilization methods, transducers, and fabrication techniques.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2009-2010 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

BE 5755 - Medical Devices

An introduction to medical devices used for diagnosis, monitoring, and treatment in clinical medicine. Topics covered include product planning, reliability, clinical trial design, regulatory aspects as well as technical aspects of common medical devices.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate

BE 5770 - Biomedical Microcontrollers

The focus of this course is to provide biomedical engineering students the necessary skills to develop microcontroller-based devices. Provides basic knowledge on computer programming languages, microcontrollers, digital circuits, and microcontroller development kits. Students will design and fabricate a microcontroller-based device using a microcontroller development kit for a specific biomedical application.

Credits: 3.0

Lec-Rec-Lab: (1-0-2)

Semesters Offered: Fall - Offered alternate years beginning with the 2016-2017 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

BE 5800 - Advanced Biomaterials Interfaces

This course introduces the students to the effects of topography and texture on the performance of biomaterials. Special emphasis is placed on tissue engineering scaffolds and microfabrication and nanofabrication techniques. Some of the topics include: self-organization of biomembranes and supramolecular systems, bioactive materials, and the molecular basis for surface recognition and masking.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2010-2011 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

BE 5850 - Tissue Mechanics

This course integrates continuum mechanics, experiments, and computational methods to understand soft tissue mechanics. The first half of the course is dedicated to building continuum mechanics foundation, which will be used to formulate constitutive equations for arteries and the heart in the second half.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate

BE 5900 - Biomedical Engineering Masters Topics

Biomedical engineering courses will be offered as professional electives dependent upon the interest of the faculty.

Credits: variable to 6.0; May be repeated

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Level(s): Graduate

BE 5930 - Biomedical Engineering Topics

Biomedical engineering courses will be offered on new or emerging technical subjects depending on student demand and faculty interest and expertise.

Credits: variable to 6.0; May be repeated

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Level(s): Graduate

BE 6000 - Doctoral Research

Includes the study of an acceptable biomedical engineering problem and the preparation of a report or thesis.

Credits: variable to 12.0; May be repeated; Graded Pass/Fail Only

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Level(s): Graduate

BE 6900 - Biomedical Engineering Doctoral Topics

Biomedical engineering courses will be offered as professional electives dependent upon the interest of the faculty.

Credits: variable to 6.0; May be repeated

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Biological Sciences**BL 5012 - Graduate Seminar in Biology**

Graduate students will listen to seminars given by visiting scientists that pertain to various research topics in biology. Through assignments students will gain experience in summarizing seminars and learning what makes a "good" seminar.

Credits: 1.0; May be repeated

Lec-Rec-Lab: (1-0-0)

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

BL 5021 - 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

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

Pre-Requisite(s): BL 4010

BL 5025 - The Scientific Profession

The practice of sciences for graduate students, including how to plan a research project, grantsmanship, publication, navigating the job market, and timely issues (e.g. ethical conduct, diversity and bias, etc.).

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, Junior

BL 5030 - Molecular Biology

Molecular biology of gene structure, expression and regulation. Molecular techniques and their application to biotechnology and genomes are covered.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall, Summer

Restrictions: Must be enrolled in one of the following Level(s): Graduate

BL 5034 - Community Ecology and Evolutionary Dynamics

This is an advanced course that looks at the study of ecology and evolutionary biology at the community level: how populations interact with the abiotic environment and each other to determine patterns of diversity, distribution, and abundance of plants and animals.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2014-2015 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): BL 3400 and BL 3190

BL 5035 - 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 an emphasis on sample preparation. Emphasis will be placed on application of advanced techniques. 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: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

BL 5036 - Ecology and Evolution of Interactions Between Plants, Herbivores, and Pollinators

Plants, herbivores, and pollinators have played major roles in influencing each others evolutionary diversification. We will examine the ecology and evolution of plant-herbivore- pollinator interactions in basic and applied contexts. A solid foundation of tools in ecology and evolution will be established and class will include lectures and interactive discussions from readings of primary literature. Students will design, conduct, and analyze independent research projects in the lab.

Credits: 3.0

Lec-Rec-Lab: (2-0-2)

Semesters Offered: Summer - Offered alternate years beginning with the 2019-2020 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): BL 3400 and BL 3190

BL 5038 - Epigenetics

An introduction to the fundamentals of epigenetic control that is not encoded by genomic DNA sequences of an organism. Topics include major regulatory mechanisms including DNA methylation, histone modification, and non-coding RNA (ncRNA) mediated gene regulation.

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): BL 3300 or BL 4030

BL 5042 - 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. Emphasis will be placed on application of advanced techniques. 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: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior
Co-Requisite(s): BL 5035

BL 5044 - Human Pathophysiology

Course will cover abnormal function (physiology) and investigate the signs and symptoms of major diseases in humans. Extension of Anatomy & Physiology by working through the systems of the human body. Course will include a clinical focus and case-study approach.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2020-2021 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): BL 2010 and BL 2020

BL 5051 - Scientific Writing and Publishing

This course is designed to give graduate students the skills necessary to write and publish scientific journal articles. Topics covered include: general principles of scientific writing, plagiarism and ethics in publishing, critical evaluation of scientific articles, and using reviewers' comments to improve the quality of articles.

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, Junior

BL 5052 - Fluorescence and Video Microscopy of Biological Sciences

Hands-on training in fluorescence microscopy and video microscopy. Students prepare biological specimens of their choice for observation. Emphasis will be placed on application of advanced techniques. Half semester course.

Credits: 2.0

Lec-Rec-Lab: (0-2-6)

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, Sophomore, Junior
Pre-Requisite(s): BL 5035

BL 5062 - 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. Emphasis will be placed on application of advanced techniques. Successful completion of course is prerequisite to becoming a certified TEM operator in the 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 5035

BL 5070 - Environmental Toxicology

Introduction to the range anthropogenic pollutants released into the environment. Concepts of bioaccumulation, biomagnification and environmental persistence, modes of toxicity and detoxification, transport and fate in aquatic and terrestrial ecosystems. Toxic equivalent factors and quotients, regulatory guidelines and practices.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Medical Laboratory Science, Biochem & Molec Biology-Bio Sc, Bioinformatics, Pharmaceutical Chemistry
Pre-Requisite(s): (BL 1020 or BL 1040) and CH 1160

BL 5120 - Environmental Remediation

Toxicology of major environmental pollutants, their dose-response relationships and fundamentals of environmental remediation. Topics include physical, chemical, and biological remediation methods and effect of environmental toxins on biological systems. Laboratory will involve the application of chemical and biological remediation techniques.

Credits: 3.0

Lec-Rec-Lab: (2-0-2)

Semesters Offered: Fall - Offered alternate years beginning with the 2011-2012 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

Pre-Requisite(s): BL 1020 or BL 1040

BL 5145 - 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, Junior

BL 5200 - Microbial Physiology

Structure and function of microorganisms, with emphasis on mechanisms for responding to changing environmental and nutritional conditions.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2018-2019 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): BL 3210 or BL 3310

BL 5300 - Applied Genomics

This course is an overview of techniques involved in genomics including hands-on experience in next-generation sequencing (NGS) platforms, and NGS sequence analysis including de novo assembly, gene annotation, and analysis including comparative genomics, pathway mapping, and core and pan genome analysis.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2019-2020 academic year

BL 5340 - Special Topics in Biology

A discussion of recent developments in the biological sciences. Recent offerings have included population genetics, taxonomy of aquatic insects, herpetology, bryology, fungi, and lichens.

Credits: variable to 10.0; Repeatable to a Max of 10

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

BL 5350 - Special Topics in Physiology

A discussion of recent developments in physiology. Recent offerings have included respiratory physiology, renal physiology, clinical cardiology, and neurophysiology.

Credits: variable to 10.0; Repeatable to a Max of 10

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

BL 5360 - Special Topics in Biochemistry

A discussion of recent developments in the field of biochemistry. Topics taught recently include steroid biochemistry, immunology, and metabolic control theory.

Credits: variable to 10.0; Repeatable to a Max of 10

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

BL 5370 - Special Topics in Microbiology

A discussion of recent developments in the field of microbiology. Topics taught recently include bacterial genetics, industrial microbiology, and advanced microbial ecology.

Credits: variable to 10.0; Repeatable to a Max of 10

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

BL 5371 - Advanced Cell Biology

This course is to develop an understanding of the structure and function of the cell. Course topics include details of basic genetic mechanisms, cell structure and function, and examination of cells in their social context.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): (BL 2200 or BL 3012) and (CH 2420 or BL 4010)

BL 5380 - Special Topics in Ecology

A discussion of recent developments in the field of ecology. Topics taught recently include systems ecology, ecology of Great Lakes fisheries, ecology of algae, aquatic macrophytes, and world ecosystems.

Credits: variable to 10.0; Repeatable to a Max of 10

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

BL 5390 - Special Topics in Clinical Laboratory Science

A discussion of recent developments in clinical laboratory science.

Credits: variable to 10.0; Repeatable to a Max of 10

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

BL 5400 - Special Topics in Plant Sciences

A discussion of recent developments in plant science. Topics may include biotechnology, physiology, systematics, phylogenetics, biochemistry, and molecular genetics.

Credits: variable to 10.0; Repeatable to a Max of 10

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

BL 5421 - Lake Superior Exploration

Field intensive course with significant time spent on a research vessel (R/V Agassiz or some other) where students will learn the use of a variety of state-of-the-art techniques to characterize biological communities and measure important physical and biological processes.

Credits: 3.0

Lec-Rec-Lab: (4-0-6)

Semesters Offered: Summer - Offered alternate years beginning with the 2018-2019 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

BL 5447 - Stream Ecology

Field course combining river and stream ecosystem and foodweb study with fishes in lake systems. Students will be exposed to research methods used in lakes for comprehensive abiotic and biotic understanding.

Credits: 4.0

Lec-Rec-Lab: (3-0-3)

Semesters Offered: Summer - Offered alternate years beginning with the 2019-2020 academic year

BL 5451 - Advanced Ecology

This course will provide advanced coverage of ecological pattern, science, and theory of aquatic and terrestrial systems and their interface. Topics will range from individuals and populations to communities and landscapes. Lectures and discussions will be guided by published literature.

Credits: 3.0

Lec-Rec-Lab: (2-1-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2018-2019 academic year

Restrictions: Permission of instructor required

BL 5461 - Ecosystem Ecology

History, key concepts, and practice of ecosystem ecology in aquatic and terrestrial environments. Emphasizes inter-connectedness of energy and nutrient flows globally and in regional 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: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): BL 3400 and CH 1122 or (CH 1160 and CH 1161)

BL 5500 - Graduate Seminar in Biological Sciences

Analysis, evaluation, and synthesis of primary scientific literature on a specific topic in recitation/discussion format.

Credits: 1.0; Repeatable to a Max of 4

Lec-Rec-Lab: (0-1-0)

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

BL 5501 - Graduate Research Seminar Ecology/Environmental

Seminar is designed to facilitate critical discussions of student research projects at various stages of their development. The presenter will provide an overview or seminar on their project and research goals, which will establish the foundation for the discussion thereafter.

Credits: 1.0; May be repeated

Lec-Rec-Lab: (0-1-0)

Semesters Offered: Spring

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

BL 5503 - Graduate Research Seminar Biomolecular

Seminar is designed to facilitate critical discussions of student research projects at various stages of their development. The presenter will provide an overview or seminar on their project and research goals, which will establish the foundation for the discussion thereafter.

Credits: 1.0; May be repeated

Lec-Rec-Lab: (0-1-0)

Semesters Offered: Fall

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

BL 5678 - Biological Sciences Field Service

This course provides a supervised field experience in biological sciences, natural resources, and community development.

Credits: 1.0; May be repeated

Lec-Rec-Lab: (0-0-3)

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Biological Sciences

BL 5752 - Cancer Biology

Emphasis on characteristic genetic, molecular, and cellular changes leading to cancer. Topics will include the role of tumor viruses, oncogenes, tumor suppressors, immortalization, apoptosis, and angiogenesis in cancer initiation, and/or progression. Consideration of current therapies and future directions for treatment.

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): BL 3012 or BL 4370 or BE 2400

BL 5800 - Molecular Diagnostics

This course provides the scientific background behind modern molecular techniques applied in the diagnosis of human diseases. Topics to be covered include nucleic acid structure and function as well as introduction to nucleic acid characterization techniques used in disease diagnosis and genetic disorders.

Credits: 5.0

Lec-Rec-Lab: (3-0-2)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

BL 5990 - Masters Research in Biological Sciences

An original investigation in biology that culminates in a thesis.

Credits: variable to 15.0; May be repeated; Graded Pass/Fail Only

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Level(s): Graduate

BL 5994 - International Biological Sciences Practicum

Thesis or project work conducted by graduate students enrolled in the Peace Corps Master's International Program in Biological Sciences.

Credits: 1.0; Repeatable to a Max of 18

Lec-Rec-Lab: (0-0-1)

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Biological Sciences

BL 6990 - Doctoral Research in Biological Sciences

An original investigation in theoretical or experimental biology, or both, and submission of a dissertation in partial fulfillment of the requirements for the PhD degree.

Credits: variable to 15.0; May be repeated; Graded Pass/Fail Only

Semesters Offered: Fall, Spring, Summer

Biochemistry & Molecular Biology

BMB 6010 - Advanced Biochemistry

Course will focus on the relationships between structure and function of proteins, nucleic acids, lipids, and carbohydrates. Specific topics include enzyme catalysis; binding and allostery; protein-protein, protein-carbohydrate, and protein-nucleic acid interactions; membrane function, and, signal transduction.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate

BMB 6020 - Advanced Molecular Biology

Course will focus on gene structure, gene duplication, gene expression, gene regulation, DNA recombination, DNA repair and transposition. Comparison between prokaryotes and eukaryotes will be drawn. Genomics and modern biotechnology methods will be discussed. Classic and current papers may accompany the lecture material. Foundations in basic biochemistry and molecular biology are required for this course.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

BMB 6030 - Modern BMB Laboratory

This is an intensive laboratory course that focuses on protein chemistry, nucleic acid chemistry, genomics and biotechnology. Students will rotate between research labs of four faculty where they will gain in-depth laboratory experience in modern biochemistry and molecular biology.

Credits: 3.0

Lec-Rec-Lab: (0-0-9)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

BMB 6990 - Doctoral Research in Biochemistry and Molecular Biology

Original research that culminates in a PhD dissertation.

Credits: variable to 12.0; May be repeated; Graded Pass/Fail Only

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Civil & Environmental Engineering

CEE 5101 - Bituminous Materials

Applications and properties of asphalt binder, aggregates for bituminous mixtures, and analysis and design of asphalt concrete mixtures. Includes asphalt cement production, rheology, chemistry, and grading, aggregate grading and blending, and mixture design and characterization. Also discusses asphalt mixture production, construction, and recycling.

Credits: 3.0

Lec-Rec-Lab: (0-2-2)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): CE 3101 or CEE 3101

CEE 5102 - Advanced Concrete Materials

Properties and applications of portland cement and portland cement concrete. Includes cement production, chemistry and hydration, concrete admixtures, and the properties of fresh and hardened concrete. Presents concrete microstructure and durability. Other topics include high-strength and high early-strength concrete, fiber-reinforced concrete, and advanced cement-based materials.

Credits: 3.0

Lec-Rec-Lab: (0-2-2)

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

CEE 5109 - Sustainable Pavement Engineering and Civil Engineering Materials

This class will develop fundamental knowledge of sustainable pavements, recycled materials, asphalt and concrete materials, basic concept of characterization of pavement materials, data analysis, and basic modeling procedures. The course will cover a wide range of advanced knowledge of sustainable pavements and materials.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring

Restrictions: Permission of instructor required

Pre-Requisite(s): CE 3101 or CEE 3101

CEE 5190 - Special Topics in Civil Engineering Materials

Advanced study of materials related topics, including discussions of recent research developments at an advanced level.

Credits: variable to 3.0; Repeatable to a Max of 6

Semesters Offered: Fall, Spring, Summer

CEE 5201 - Advanced Structural Analysis

The study of nonlinear structural analysis techniques, especially energy methods, applied to elastic buckling analysis, large deflections of beams, second-order effects in frames, plastic analysis of steel structures, and yield analysis of concrete beams and slabs.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2016-2017 academic year

Pre-Requisite(s): CE 4201 or CEE 4201

CEE 5202 - Finite Element Analysis

Introduction to the use of finite element methods in structural analysis. Covers the finite element formulation, 1- and 2-D elements, including isoparametric elements, axisymmetric analysis, plate and shell elements, dynamics, buckling, and nonlinear analysis.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Pre-Requisite(s): CE 4201 or CEE 4201

CEE 5212 - Prestressed Concrete Design

Theory of prestressed and post-tensioned members. Covers analysis and design of prestressed concrete beams, slabs, box girders, and bridge girders by elastic and ultimate strength methods. Precast and cast-in-place system construction techniques will be included.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Pre-Requisite(s): CE 4213 or CEE 4213

CEE 5213 - Concrete and Masonry Building Systems

Design of reinforced concrete two-way slabs and reinforced masonry systems for buildings. Includes design of bearing walls, shear walls, lintels, pilasters, slender columns, torsional beams and connections. A design project may be included during the semester.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Pre-Requisite(s): CE 4213 or CEE 4213

CEE 5223 - Steel Design II

Additional topics in steel design including beam-columns, floor vibrations, diaphragms, buckling behavior of thin elements, torsional buckling, and beam and column bracing. Includes an introduction to cold-formed steel design.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Pre-Requisite(s): CE 4223 or CEE 4223

CEE 5233 - Advanced Structural Timber Design

Advanced design of timber structures, including arches and traditional timber frames, advanced shear wall design, advanced connection design, including timber connectors, and advanced analysis and behavior of wood, including cumulative damage modeling.

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): CE 4233 or CEE 4233

CEE 5241 - Structural Dynamics

Free and forced vibration of undamped and damped single degree of freedom systems. Multiple degree-of-freedom systems, including shear buildings and frames. Basic seismic design.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Pre-Requisite(s): CE 4201 or CEE 4201(C)

CEE 5242 - Advanced Structural Dynamics

Earthquake engineering and advanced dynamic analysis. Includes time history response of multiple degree-of-freedom systems, seismicity, equivalent static force method, modal analysis, base isolation, soil-structure interaction, and an introduction to random vibrations.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Pre-Requisite(s): CE 5241 or CEE 5241

CEE 5250 - Special Topics in Structural Engineering

Advanced study of structural engineering topics, including discussions of recent research developments at an advanced level. Topics might include loading analysis, advanced topics in steel design, composite materials for structures, and behavior of a variety of reinforcements for concrete applications.

Credits: variable to 3.0; Repeatable to a Max of 6

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Level(s): Graduate

CEE 5261 - Bridge Design and Construction

Introduction to design and behavior of short and medium span bridges. Topics include aesthetics, preliminary design and layout, design of prestresses and plate girders bridges, deck design, foundation design. Project may alternate between structural steel and prestressed concrete member design.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Pre-Requisite(s): (CE 4213 or CEE 4213) and (CE 4223 or CEE 4223)

CEE 5350 - Infrastructure Life Cycle Engineering

The course examines how life cycle assessment (LCA), life cycle costing analysis (LCCA), green rating systems, value engineering and alternative project delivery systems influence design decisions and project outcomes. Topics will be discussed within the context of the underlying scientific principles and relevant standards.

Credits: 3.0

Lec-Rec-Lab: (2-0-1)

Semesters Offered: Spring - Offered alternate years beginning with the 2020-2021 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

CEE 5390 - Special Topics in Construction Engineering

Advanced study of construction engineering topics including discussion of recent research developments.

Credits: variable to 3.0; Repeatable to a Max of 6

Semesters Offered: Fall, Spring, Summer

CEE 5400 - 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: (3-0-0)

Semesters Offered: Fall

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

Pre-Requisite(s): (CE 3401 or CEE 3401) and (CE 3101 or CEE 3101)

CEE 5401 - Advanced Pavement Design

Advanced analysis, behavior, performance, and structural design of highway and airport pavements. Focuses on mechanistic characterization of pavement structures and approaches used to characterize existing structures for the purpose of rehabilitation. Subjects include advanced materials characterization, mechanistic modeling, nondestructive testing, and pavement rehabilitation. Includes airport pavement design and rehabilitation.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

Pre-Requisite(s): (CE 3401 or CEE 3401) and (CE 3101 or CEE 3101)

CEE 5402 - Traffic Flow Theory

This course is an introduction to traffic flow theory. Course is concerned with the behavior of vehicular traffic as a complex system through the development of mathematical models of these processes. Topics will include macroscopic and microscopic traffic flow theory, as well as connected and automated vehicles.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2019-2020 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

Pre-Requisite(s): CEE 4402

CEE 5404 - Transportation Planning

An introduction to urban transportation planning, planning data collection, transportation planning models, and development and evaluation of transportation plans. Includes extensive use of transportation planning software to evaluate transportation plans in multimodal networks.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

CEE 5408 - Public Transit

An introduction to public transit, user characteristics, management, transit modes, data collection and surveys, planning, operations, scheduling, transit finances, and future trends.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

CEE 5414 - Railroad Engineering

Rail transportation systems require infrastructure, vehicles, motive power and energy, and control systems to move goods and people. This multi-disciplinary course provides students with understanding of these system components and related engineering and technology enabling efficient operation of today's system.

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): CEE 3490 or CE 4490

CEE 5417 - Transportation Design

Introduction to computer aided geometric design of highways and railways.

Covers design principles and use of standards for horizontal and vertical alignments and cross sections, including road intersections, railway turnouts and grade crossings. Students develop engineering drawings and related cost estimates for road/rail project.

Credits: 4.0

Lec-Rec-Lab: (3-0-2)

Semesters Offered: Spring

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

Pre-Requisite(s): (CE 3401 or CEE 3401) and SU 2000

CEE 5490 - Special Topics in Transportation Engineering

Topics of special interest in transportation engineering.

Credits: variable to 3.0; Repeatable to a Max of 6

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required

CEE 5501 - Environmental Process Engineering

Review of mass transfer, kinetics, reactor design, and mathematical modeling principles. Includes illustration by application to several important natural systems and environmental engineering unit processes. Mathematical models of selected environmental engineering systems are developed and solved using PCs.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate

CEE 5502 - Biological Treatment Processes

Application of kinetics, reactor theory, and microbiology to modeling and design of aerobic and anaerobic wastewater treatment systems. Topics include activated sludge process models and application of these models to process design and operation.

Credits: 3.0

Lec-Rec-Lab: (0-2-3)

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): ENVE 4502 or CEE 4502 or ENVE 4508

CEE 5503 - Physical-Chemical Treatment Processes

Advanced theory, fundamentals, and application of physical and chemical processes employed in design and operation of drinking water treatment systems.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): ENVE 5501 or CEE 5501

CEE 5504 - Modeling and Management of Lakes and Rivers

Principles of surface water quality management are introduced and examined in the context of the mathematical models used to design and test lake and river management strategies. Case histories and guest lectures will be provided to broaden students' exposure.

Credits: 3.0

Lec-Rec-Lab: (0-2-3)

Semesters Offered: Spring

Pre-Requisite(s): ENVE 4505 or CEE 4505 or BL 4450

CEE 5508 - Global Biogeochemistry

This course gives an overview of important biogeochemical processes occurring in land, air, and water. An emphasis is put on modeling as an integrating tool.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2015-2016 academic year

Pre-Requisite(s): ENVE 4501 or CEE 4501

CEE 5509 - Transport and Transformation of Organic Pollutants

Assessment of factors controlling environmental fate, distribution, and transformation of organic pollutants. Thermodynamics, equilibrium, and kinetic relationships are used to quantify organic pollutant partitioning and transformations in air, water, and sediments. Use of mass balance equations to quantify pollutant transport.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2010-2011 academic year

Pre-Requisite(s): ENVE 4501 or CEE 4501 or CH 3510

CEE 5510 - Practical Applications and Analytical Techniques for Environmental Measurements

Develop methods and skills for laboratory work required for experimental research in environmental engineering. Topics include laboratory safety, quality control/quality assurance, purchasing, and use of analytical equipment. Students select one or more of the following topics for specialized study: GC, AA, carbon analysis, HPLC, UV/Vis spectroscopy, liquid scintillation counting.

Credits: variable to 3.0

Semesters Offered: Fall, Summer

Restrictions: Permission of instructor required

CEE 5512 - Applied Boundary Layer Meteorology

Study of how forcing phenomena affect transport of water and chemicals in the atmospheric boundary layer and how this transport is measured in the field, including relevant aspects of fluid dynamics, boundary layer structure, surface energy balance, and flux measurement.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2014-2015 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

CEE 5515 - Atmospheric Chemistry

Study of the photochemical processes governing the composition of the troposphere and stratosphere, with application to air pollution and climate change. Covers radical chain reaction cycles, heterogeneous chemistry, atmospheric radiative transfer, and measurement techniques for atmospheric gases.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): ENVE 4501 or CEE 4501 or ENVE 4504 or CEE 4504 or CH 3510

CEE 5517 - Soil Biogeochemistry

Study of the relationship between soil composition and the circulation of major elements through the earth system. Responses of biogeochemical cycles of the elements in agricultural, forest, grassland, and wetland soils to changes in landuse, biodiversity, nutrient supply, plant stressors, and climate change will be discussed.

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): CH 1150

CEE 5518 - Aquatic Biogeochemistry

Covers interactions among chemical, biological, and physical processes within aquatic ecosystems as well as role of aquatic ecosystems in global biogeochemistry. Modeling as an integrative tool is stressed.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2014-2015 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

CEE 5519 - Atmospheric Biogeochemistry

Study of the relationship between atmospheric composition, global change, and the circulation of major elements through the Earth system. Responses of ecosystem emissions to changes in landuse, biodiversity, nutrient supply, plant stressors, and climate change are discussed.

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, Sophomore

CEE 5520 - Introduction to Hydrodynamic Modeling

Introduce fundamental concept and numerical methods used in hydrodynamic modeling, physical process in the hydrodynamic system and their numerical representation using governing equations. Students construct simplified numerical models with application to problems of coastal oceans and large lakes, as well as engineering systems of interest to environmental and other engineers.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

Pre-Requisite(s): MA 3520 or MA 3521 or MA 3530 or MA 3560

CEE 5521 - Bioremediation Engineering

Introduction to the microbiological and engineering fundamentals of bioremediation. Topics include relevant microbial biochemistry, physiology, and ecology; necessary site data; design and operation of current and emerging bioremediation systems; monitoring methods for bioremediations projects; and technical evaluation of selected case studies.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2019-2020 academic year

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

CEE 5560 - Advanced Topics in Air Quality Engineering

Advanced study of topics related to atmospheric chemistry and/or modeling the transformation and transport of atmospheric pollutants.

Credits: variable to 4.0; Repeatable to a Max of 8

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required

CEE 5561 - Advanced Topics in Biological Processes

Advanced study of biological processes associated with natural and engineering systems.

Credits: variable to 4.0; Repeatable to a Max of 8

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required

CEE 5562 - Advanced Topics in Physical-Chemical Processes

Advanced study of physical and chemical processes that occur in natural and engineered systems.

Credits: variable to 4.0; Repeatable to a Max of 8

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required

CEE 5563 - Advanced Topics in Surface Water Quality Engineering

Advanced topics related to understanding the biogeochemistry of surface waters (lakes, rivers, wetlands) and the mathematical modeling of those systems.

Credits: variable to 4.0; Repeatable to a Max of 8

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required

CEE 5590 - Special Topics in Environmental Engineering

Advanced study of environmental engineering topics including discussion of recent research developments.

Credits: variable to 3.0; Repeatable to a Max of 6

Semesters Offered: Fall, Spring, Summer

CEE 5620 - Stochastic Hydrology

Application of statistics to problems in surface hydrology. Topics include the flood flow and streamflow frequency analysis, goodness-of-fit tests, model selection, treatment of historical and censored data, regionalization and regression, time series analysis, Bayesian inference, sensitivity and uncertainty analysis methods.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand

Pre-Requisite(s): CEE 3620 and (CEE 3710 or CEE 3502 or MA 3710)

CEE 5630 - Advanced Hydrology

Students will understand hydrologic processes such as transpiration, evaporation, infiltration, base flow, and surface runoff. Students will learn principles of hydrometeorology, principles of sustainability applied to surface water resources, how to collect/analyze hydrologic data, and how to predict/estimate hydrologic responses.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2019-2020 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

Pre-Requisite(s): CE 3620 or CEE 3620

CEE 5640 - Stormwater Management and LID

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: Summer

Pre-Requisite(s): CE 3620 or CEE 3620

CEE 5665 - Stream Restoration

Basin mechanics of the transport of sediments in natural systems, including tractive forces and geomorphic functions.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall, Spring

Pre-Requisite(s): CE 3620 or CEE 3620

CEE 5666 - Water Resources Planning and Management

Economic and environmental aspects of water use. Topics include flood damage reduction, water demand and hydrologic forecasting, water supply planning, and water resource systems operation.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Pre-Requisite(s): (CE 3620 or CEE 3620) and EC 3400

CEE 5680 - Geophysical Fluid Dynamics

Fundamental forces and conservation laws that govern fluid flow; applications to the atmosphere and ocean, including balanced flow (pressure gradient and Coriolis Force), vorticity dynamics, turbulence, waves and boundary layers.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2017-2018 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

Pre-Requisite(s): PH 2300 and (MA 3520 or MA 3521 or MA 3530 or MA 3560)

CEE 5690 - Special Topics in Water Resources

Advanced study of water resources topics including discussion of recent research developments.

Credits: variable to 3.0; Repeatable to a Max of 6

Semesters Offered: Fall, Spring, Summer

CEE 5710 - Modeling and Simulation Applications for Decision-Making in Complex Dynamic Systems

Introduces students to the theory and application of modeling techniques and simulations in the analysis of decision alternatives in complex engineering problems. Topics include queuing theory, system dynamics modeling, agent-based modeling, discrete event simulations, etc. Students will be required to conceptualize and implement an appropriate research/engineering problem of choice (this could be a dissertation/thesis problem).

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2019-2020 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

CEE 5730 - Probabilistic Analysis and Reliability

Examines probabilistic analysis of engineering systems including first-order methods, Monte Carlo simulation, and time-to-failure analysis. Reliability analysis will include capacity/demand reliability and system reliability. Emphasis will be on civil and environmental engineering systems.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Pre-Requisite(s): CE 3710 or CEE 3710 or MA 3710

CEE 5740 - Frequency-Domain Modeling and Identification of Continuous Civil Engineering Systems

Introductory course in modeling of continuous systems with an emphasis on frequency and complex-domain analysis for civil engineering systems. Potential applications include system identification and control. Preliminary topics include data acquisition and signal conditioning, Fourier, Laplace, and Z-transforms.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): MA 3520 or MA 3521 or MA 3530

CEE 5760 - Optimization Methods in Civil and Environmental Engineering

Decision analysis and optimization techniques, including linear programming, nonlinear programming, and dynamic programming. Computer-based solutions of design problems in various civil and environmental engineering specialty areas are considered.

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): MA 2160 and (MA 2320 or MA 2321 or MA 2330)

CEE 5800 - Mathematical Modeling of Earth Systems

Introduction to numerical techniques for mathematical modeling of various earth-system phenomena, including groundwater flow, heat transfer, and atmospheric transport. Numerical techniques covered include finite-difference, finite-element, collocation, and characteristic methods. Students write their own mathematical models. Prerequisite: experience in programming computer languages such as FORTRAN.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate

CEE 5810 - Advanced Soil Mechanics

Provides advanced studies in the topics of soil compressibility and soil strength.

Develop advanced procedures for determining stress distribution and stress changes from a fundamental basis. Students are strongly advised to take CE5820 concurrently.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

Pre-Requisite(s): CE 3810 or CEE 3810

CEE 5811 - Fundamentals of Soil Behavior and Engineering Laboratory

The course will focus on the fundamentals of soil behavior through coursework and laboratory investigation. Coursework will include soil formation, composition, engineering properties, conduction phenomena, strength, and volume change. Laboratory testing will include 1D consolidation, permeability, and monotonic and cyclic triaxial testing.

Credits: 4.0

Lec-Rec-Lab: (3-0-3)

Semesters Offered: Fall, Spring

Pre-Requisite(s): CE 5810 or CEE 5810

CEE 5870 - Multiphysics of Porous Materials

Overview of multiphysics, typical multiphysical phenomena in porous materials, and the simulation of these phenomena using numerical techniques.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand

Pre-Requisite(s): MA 2160

CEE 5890 - Special Topics in Geotechnical Engineering

Advanced study of geotechnical engineering topics including discussion of recent research developments.

Credits: variable to 3.0; Repeatable to a Max of 6

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Level(s): Graduate

CEE 5920 - Civil Engineering Independent Study

Approved research or design project in civil engineering, originating with an individual student or assigned by the instructor.

Credits: variable to 3.0; Repeatable to a Max of 6

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

CEE 5930 - Environmental Engineering Independent Study

Approved research or design project in environmental engineering, originating with an individual student or assigned by the instructor.

Credits: variable to 3.0; Repeatable to a Max of 6

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Level(s): Graduate

CEE 5990 - Civil Engineering Graduate Seminar

Detailed study and group discussions of current literature and graduate research projects related to the broad field of civil engineering. Topics will be combined to address the student's area of interest, including construction, environmental, geotechnical, structures, transportation, and water resources. External speakers discuss current related issues.

Credits: 1.0

Lec-Rec-Lab: (0-1-0)

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

CEE 5991 - Environmental Engineering Graduate Seminar I

Presentations and discussion of current literature and research related to the broad field of environmental engineering.

Credits: 1.0

Lec-Rec-Lab: (0-1-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Environmental Engineering, Civil Engineering

Engineering

CEE 5992 - Environmental Engineering Graduate Seminar II

Presentations and discussion of current literature and research related to the broad field of environmental engineering.

Credits: 1.0

Lec-Rec-Lab: (0-1-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Environmental Engineering, Civil Engineering

Engineering

CEE 5993 - Engineering with Developing Communities

Study of applying appropriate, community-based, and sustainable engineering in developing communities. Concepts of human-centered design and sustainable development are covered. Topics are drawn from several areas of engineering, including water and wastewater treatment, construction materials, solid waste, energy, and information systems.

Credits: 2.0

Lec-Rec-Lab: (0-1-2)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate; May not be enrolled in one of the following Class(es): Freshman, Sophomore

Pre-Requisite(s): (ENG 2120 or MEEM 2150) and (CE 3620 or CEE 3620)

CEE 5994 - International Civil & Environmental Engineering Field Experience

Field work and reporting from students in the Peace Corps Master's International Program in Civil & Environmental Engineering.

Credits: 1.0; May be repeated

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

CEE 5997 - Natural Resources Engineering Field Service

This course provides a supervised field experience in natural resources engineering and community development.

Credits: 1.0; May be repeated

Lec-Rec-Lab: (0-0-3)

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

CEE 5998 - Engineering Design Practicum

Advanced independent study for students in the Master of Engineering program.

In consultation with student's advisor, develop and execute a project demonstrating capabilities in problem solving, communications, and decision making. The practicum can be done on campus or at the site of a Michigan Tech corporate partner.

Credits: variable to 4.0; Repeatable to a Max of 4

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

CEE 5999 - Master's Research

Study of an acceptable civil or environmental engineering problem and preparation of a report or thesis.

Credits: variable to 10.0; May be repeated; Graded Pass/Fail Only

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Level(s): Graduate

CEE 6999 - Doctoral Research

Original research leading to the preparation of a dissertation in partial fulfillment of the requirements for the PhD degree.

Credits: variable to 10.0; May be repeated; Graded Pass/Fail Only

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Environmental Engineering, Engineering - Environmental, Civil Engineering

CH 5130 - Professional Development: Chemical Safety

The course will examine Michigan Tech's Chemical Hygiene Plan, understand responsibilities as lab workers, learn how to write Standard Operating Procedures, how to conduct safety inspections, how to be safer in a chemical lab environment and review OSHA rules and regulations regarding conducting research in a chemical laboratory.

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

Pre-Requisite(s): CH 3510 or CH 3540

CH 5140 - Introduction to Pharmaceutical Analysis

This course will present a systematic introduction to chemical analysis of pharmaceutical raw materials, finished pharmaceutical products, and of drugs in biological fluids, which are carried out in pharmaceutical laboratories worldwide.

Credits: 3.0

Lec-Rec-Lab: (2-0-2)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

CH 5210 - Analytical Separations

Covers theory and applications of modern gas chromatography, high performance liquid chromatography, and ion chromatography as well as instrumentation for these techniques. Studies trace organic analysis and environmental problems.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

CH 5240 - Advanced Mass Spectrometry

Advanced instrumentation and methods are the focus of this course. Design of various mass analyzers and their advantages and limitations will be reviewed. Advanced identification methods such as tandem mass spectrometric analysis and exact mass analysis will be discussed.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2017-2018 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

Pre-Requisite(s): CH 4212 or CH 4222

CH 5241 - Advanced Mass Spectrometry Laboratory

Students will learn how to perform mass spectrometry (MS) experiments to identify and quantify molecules. The experiments will include the following method approaches: electrospray ionization (ESI), matrix associated laser desorption ionization (MALDI) and tandem MS analysis (MS/MS).

Credits: 1.0

Lec-Rec-Lab: (0-0-1)

Semesters Offered: Spring - Offered alternate years beginning with the 2017-2018 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

Co-Requisite(s): CH 5240

Pre-Requisite(s): CH 4212 or CH 4222

CH 5310 - Advanced Inorganic Chemistry

Covers the organometallic chemistry of the transition elements, beginning with a historical overview of the subject, as well as basic ideas in complex and transition metal chemistry.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

Pre-Requisite(s): CH 4320

CH 5410 - Advanced Organic Chemistry: Reaction Mechanisms

Advanced study of mechanistic organic and physical organic chemistry intended to bring the student to the level of current research activity. Topics may include methods for determining organic reaction mechanisms, chemical bonding as it applies to organic compounds, structure-reactivity relationships, molecular rearrangements, and molecular orbital theory.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

CH 5412 - Spectroscopy of Organic Chemistry

Emphasizes spectral data interpretation to determine structures of organic compounds. Discuss proton and carbon nuclear magnetic resonance (including two-dimensional techniques), training to perform structural analysis (UV, NMR, MS); will be given unknown organic molecules for analysis and structural elucidation.

Credits: 3.0

Lec-Rec-Lab: (2-0-2)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Chemistry

CH 5110 - 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: Must be enrolled in one of the following Level(s): Graduate

CH 5120 - 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: Must be enrolled in one of the following Level(s): Graduate

CH 5420 - Advanced Organic Chemistry: Synthesis

Advanced study of organic reactions and synthetic organic chemistry intended to bring the student to the level of current research activity. Topics may include retrosynthetic analysis and synthesis design, synthons, protecting groups, and analysis of syntheses from recent literature.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

CH 5509 - Transport and Transformation of Organic Pollutants

Assessment of factors controlling environmental fate, distribution, and transformation of organic pollutants. Thermodynamics, equilibrium, and kinetic relationships are used to quantify organic pollutant partitioning and transformations in air, water, and sediments. Use of mass balance equations to quantify pollutant transport.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2005-2006 academic year

Pre-Requisite(s): ENVE 4501 or CEE 4501 or CH 3510

CH 5515 - Atmospheric Chemistry

Study of the photochemical processes governing the composition of the troposphere and stratosphere, with application to air pollution and climate change. Covers radical chain reaction cycles, heterogeneous chemistry, atmospheric radiative transfer, and measurement techniques for atmospheric gases.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): CH 3510 or ENVE 4501 or ENVE 4504 or CEE 4501 or CEE 4504

CH 5516 - Aerosol and Cloud Chemistry

This course is focused on the chemistry of atmospheric aerosols and cloud processes. Students will learn about methods for chemical characterization, the chemical composition of aerosol and the chemical reactions pertinent to secondary aerosol and cloud composition.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2019-2020 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

CH 5517 - Soil Biogeochemistry

Study of the relationship between soil composition and the circulation of major elements through the earth system. Responses of biogeochemical cycles of the elements in agricultural, forest, grassland, and wetland soils to changes in landuse, biodiversity, nutrient supply, plant stressors, and climate change will be discussed.

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

CH 5519 - Atmospheric Biogeochemistry

Study of the relationship between atmospheric composition, global change, and the circulation of major elements through the earth system. Responses of ecosystem emissions to changes in landuse, biodiversity, nutrient supply, plant stressors, and climate change are discussed.

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, Sophomore, Junior

CH 5520 - Chemical Kinetics

An advanced study of chemical reaction rates, collision theory, enzyme kinetics, reaction dynamics, transition state theory, photochemistry, atmospheric chemistry, including methods of analysis and theory of rate processes.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand

Pre-Requisite(s): CH 3510

CH 5535 - Physical Chemistry III - Molecular Driving Forces from Fundamentals to Applications

Advance course design to bridge concepts in thermodynamics, kinetics, and quantum chemistry through the application of statistical mechanics to understand the molecular driving forces acting in chemical/physical/material/biological systems at both microscopic, and macroscopic level.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2018-2019 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): CH 3510 and CH 3520

CH 5550 - Solid State Chemistry

Introduces principles of solid state chemistry and the application to produce compounds with the desired physical and chemical properties. Discusses reactivity, preparation techniques, structure, impurity or dopant effects, phase transformations, electric and magnetic properties, and point defect chemistry.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand

Pre-Requisite(s): CH 3520

CH 5560 - Computational Chemistry

Focuses on the theory and method of modern computational techniques applied to the study of molecular properties and reactivity through lecture and computer projects. Covers classical mechanical as well as quantum mechanical approaches.

Credits: 3.0

Lec-Rec-Lab: (2-0-3)

Semesters Offered: Fall - Offered alternate years beginning with the 2010-2011 academic year

Pre-Requisite(s): CH 3520

CH 5570 - Advanced Biophysical Chemistry

A discussion of experimental techniques and applications of physical chemistry principles to the study of the structure, dynamics, and chemical reactions of proteins, nucleic acids, and other biopolymers.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand

Pre-Requisite(s): CH 3520

CH 5665 - Surface and Interface Science for Chemical and Materials Analysis

Coursework and hands-on laboratory experiences explore physical and chemical properties governing surface processes and the appropriate analysis techniques used to study interfaces and surface chemical reactions. Topics include principles of physical chemistry and materials science for understanding and applying modern surface analysis.

Credits: 3.0

Lec-Rec-Lab: (2-0-3)

Semesters Offered: On Demand

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

CH 5730 - Confocal Laser Scanning Microscopy: Foundations, Applications, and Advances

Principles of fluorescence microscopy, confocal microscope design, practical aspects of confocal microscopy, live cell imaging, high speed imaging, fluorescent stains, quantitative fluorescence, immunofluorescence, fluorescent proteins, biosensors. Confocal applications in biology and health related sciences will be covered.

Credits: 1.0

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

CH 5800 - Special Topics in Graduate Chemistry

Discussion of special topics in chemistry at the graduate level.

Credits: variable to 3.0; Repeatable to a Max of 12

Semesters Offered: On Demand

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

CH 5820 - Independent Study in Chemistry

Individualized project-based course designed to integrate academic and professional interests to foster student's career goals. Project can be on or off-campus, internship, or combination of these, to enhance the student's expertise and develop career-relevant skills.

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 Level(s): Graduate; Must be enrolled in one of the following Major(s): Chemistry

CH 5900 - Chemistry Graduate Seminar

Graduate seminar in chemistry.

Credits: 1.0; Repeatable to a Max of 2

Lec-Rec-Lab: (0-1-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Chemistry

CH 5990 - Chemistry Master Research

An original investigation in chemistry for students seeking an MS degree.

Credits: variable to 9.0; May be repeated; Graded Pass/Fail Only

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Level(s): Graduate

CH 6290 - Special Topics in Analytical Chemistry

Discussion of current research developments at an advanced level. Topics may include chromatography, magnetic resonance, surface analysis, mass spectrometry, or environmental analysis.

Credits: variable to 3.0; Repeatable to a Max of 9

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

CH 6390 - Special Topics in Inorganic Chemistry

Discussion of recent developments in inorganic chemistry.

Credits: variable to 3.0; Repeatable to a Max of 9

Semesters Offered: On Demand

Pre-Requisite(s): CH 4320

CH 6490 - Special Topics in Organic Chemistry

Advanced study in special areas of organic chemistry. Topics could include organic synthetic methods, production and reactions of enolate ions, heterocyclic, carbohydrate, bioorganic, or free-radical chemistry.

Credits: variable to 3.0; Repeatable to a Max of 9

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

CH 6590 - Special Topics in Physical Chemistry

A discussion of recent research developments at an advanced level. Topics could include atomic and molecular structure, kinetic theory of gases, solid-state chemistry, thermodynamics, electrochemistry, and molecular spectroscopy.

Credits: variable to 3.0; Repeatable to a Max of 9

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

CH 6640 - Synthesis of Nanoparticles

This hands-on course teaches methods of preparing different types of nanoparticles, and controlling nanoparticle size, structure, and functionalization. Students will analyze selected papers from professional literature to see emerging trends in nanoparticle design and use.

Credits: 3.0

Lec-Rec-Lab: (0-1-4)

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

CH 6690 - Special Topics in Polymer Science

Advanced study in special areas of polymer science. Topics could include thermal analysis, polymer surface science, advanced polymerization processes, scaling laws, etc. Some topics may include a laboratory component.

Credits: variable to 3.0; Repeatable to a Max of 9

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

CH 6790 - Special Topics in Biochemistry

Advanced study in special areas of biochemistry and molecular biology. Topics could include bioorganic chemistry, signal transduction or transcriptional control.

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, Junior

CH 6800 - Current Topics in Graduate Chemistry

Discussion of recent topics in chemistry at a graduate level.

Credits: variable to 3.0; Repeatable to a Max of 12

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

CH 6990 - Chemistry Doctoral Research

Laboratory research in preparation of the PhD thesis. Requires permission of the student's advisory committee and the graduate faculty.

Credits: variable to 9.0; May be repeated; Graded Pass/Fail Only

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Level(s): Graduate

CM 5300 - Advanced Transport Phenomena

Single- and multi-component mass, energy, and momentum transport. Derivation and use of the general transport equations for Newtonian and non-Newtonian flows, convective flows, and mass transport in flowing systems. Applications to complex systems.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): CM 5100

CM 5310 - Laboratory Safety

Provides the technical and cultural background necessary to operate and manage a safe Laboratory.

Credits: 1.0

Lec-Rec-Lab: (1-0-0)

Semesters Offered: Fall, Spring

CM 5400 - Adv Reactive Systems Analysis

An analytical study of various aspects of chemical reactor behavior, such as multiple steady-states, dynamics, stability, and control. Also covers transport phenomena in packed beds of solids and mathematical modeling of packed-bed reactors.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

CM 5500 - Theory and Methods of Research

Discusses modern methods of research. Topics could include statistical analysis, presentation of data, modern experimental methods, or oral presentation skills.

Credits: 2.0

Lec-Rec-Lab: (1-0-2)

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

CM 5510 - Advanced Interfacial Engineering

Examines the physics and chemistry of interfaces, and the relevance of these principles in engineering applications. It may include liquid surfaces, electric double layer, surface forces, contact angle phenomena, surfactants, adsorption, surface energy, emulsions.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2018-2019 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

CM 5715 - Advanced Biochemical Processes

Introduction to fundamental and applied industrial biochemical processing.

Topics may include basic cell and genetic design, enzymes, metabolism, bioreactor analysis and design, bioseparations and industrial applications. Graduate expectations will exceed those of the undergraduate course. Not open to students with credit in CM4710.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall, Spring - Offered alternate years beginning with the 2019-2020 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

CM 5720 - Advanced Mineral Processing

Topics in mineral processing of current interest. Will cover grinding, flotation, agglomeration, pollution prevention, surface chemistry, and other areas where rapid advancement is occurring.

Credits: variable to 3.0; Repeatable to a Max of 12

Semesters Offered: On Demand

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

CM 5721 - Literature Reviews in Chemical Engineering

Literature review course promotes learning and critical scrutiny of chemical engineering literature, on a topic pertinent to the student's research. Discussion of articles will increase knowledge breadth and depth for research. Enhances research communication skills via reviews and discussions.

Credits: 1.0; Repeatable to a Max of 9

Lec-Rec-Lab: (0-1-0)

Semesters Offered: Fall, Spring

Restrictions: Permission of instructor required

CM 5770 - Advanced 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 which students taking this course will be leading.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall, Spring - Offered alternate years beginning with the 2012-2013 academic year

Restrictions: Permission of instructor required

Chemical Engineering

CM 5100 - Appl Mathematics for CM

The solution to basic equations for momentum, mass, and heat transfer by use of separation of variables, numerical methods, and other mathematical techniques.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate

CM 5200 - Advanced CM Thermodynamics

Emphasis in phase equilibria and related concepts, such as molecular or statistical thermodynamics, nonideal fluids and solids.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate

CM 5780 - Advanced Biomanufacturing and Biosafety

Students to perform as an engineer in a biomanufacturing facility. Focus is on mammalian cell culture derived products and federal laws in biosafety. Process design software explored. Regular literature review required. Not open to students with credit in CM4780.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2014-2015 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

CM 5900 - Special Topics in CM

A discussion of chemical engineering topics of current interest not included in regular graduate courses.

Credits: variable to 3.0; Repeatable to a Max of 9

Semesters Offered: On Demand

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

CM 5950 - Advanced Special Projects

This is a course for graduate students who wish to do extensive work on projects or topics not directly related to their thesis topic and not covered in one of the graduate courses.

Credits: variable to 3.0; Repeatable to a Max of 9

Semesters Offered: On Demand

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

CM 5990 - MS Research

An original investigation of a chemical engineering problem.

Credits: variable to 15.0; May be repeated; Graded Pass/Fail Only

Semesters Offered: Fall, Spring, Summer

CM 6990 - Doctoral Research

An original investigation in theoretical or applied chemical engineering or both, and submission of a dissertation in partial fulfillment of the requirements for the PhD degree.

Credits: variable to 12.0; May be repeated; Graded Pass/Fail Only

Semesters Offered: Fall, Spring, Summer

Computer Science**CS 5000 - National Cybersecurity Policy and Law**

This course introduces the role of government in securing cyberspace. Students learn the basic national cybersecurity policy and law. Topics include federal, state, and local entities involved in cybersecurity, relevant laws and regulations, concepts of civil liberties, intellectual property, and privacy, development and diffusion of standards, and national security.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring

CS 5090 - Special Topics in Computer Science

Special topics in computer science offered on occasion based on student and faculty demand and interest.

Credits: variable to 4.0; May be repeated

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of department required

CS 5091 - Graduate Seminar in Computer Science

From time to time, depending on student demand, a seminar will be offered on advanced topics in current computer science research.

Credits: variable to 3.0; May be repeated; Graded Pass/Fail Only

Semesters Offered: On Demand

Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

CS 5130 - Compiler Design, Theory, and Optimization

Design and theory of programming language translators and the theory and implementation of optimizers. Topics include: intermediate representations, advanced code generation, control- and data-flow analysis, advanced compiler optimization, dynamic compilation, global register allocation and instruction scheduling.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): CS 4121

CS 5311 - Theory of Computation

Topics covered include Turing machines and their variants, the halting problem and decidability, computability, reducibility, NP-completeness, time and space complexity, and topics from recursive function theory. The course starts with a brief review of the computation models from CS3311.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Pre-Requisite(s): CS 3311

CS 5321 - Advanced Algorithms

Design and analysis of advanced algorithms. Topics include algorithms for complex data structures, probabilistic analysis, amortized analysis, approximation algorithms, and NP-completeness. Design and analysis of algorithms for string-matching and computational geometry are also covered.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring

Pre-Requisite(s): CS 4321

CS 5331 - Parallel Algorithms

Advanced topics in the design, analysis, and performance evaluation of parallel algorithms. Topics include advanced techniques for algorithm analysis, memory models, run time systems, parallel architectures, and program design, particularly emphasizing the interactions of these factors.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Pre-Requisite(s): CS 4431 and CS 4331

CS 5411 - Advanced Operating Systems

Advanced concepts in operating systems. Topics include real-time and multiprocessor scheduling, I/O, modern file systems, and performance analysis. Also requires a substantial implementation project.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring

Pre-Requisite(s): CS 4411

CS 5431 - Advanced Computer Architecture

An in-depth study of various aspects of parallel processing, with an emphasis on parallel architectures. The course has an analytical focus and investigates models of various aspects of the design and analysis of parallel systems. Topics include simple uniprocessor/multiprocessor performance models, pipelining, instruction-level parallelism, and multiprocessor design issues.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Pre-Requisite(s): CS 4431

CS 5441 - Distributed Systems

Covers time and order in distributed systems; mutual exclusion, agreement, elections, and atomic transactions; Distributed File Systems, Distributed Shared Memory, Distributed System Security; and issues in programming distributed systems. Uses selected case studies.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring

Pre-Requisite(s): CS 4411 and CS 4461

CS 5461 - Mobile Networks

This course will explore the Mobile network issues including routing and mobility management strategies in ad hoc networks, sensor networks, and personal area networks such as Bluetooth.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring, Summer

Restrictions: May not be enrolled in one of the following Class(es): Freshman,

Sophomore, Junior

Pre-Requisite(s): CS 4461 or EE 4272

CS 5471 - Computer Security

This covers fundamentals of computer security. Topics include practical cryptography, access control, security design principles, physical protections, malicious logic, program security, intrusion detection, administration, legal and ethical issues.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): CS 3411 or CS 4411

CS 5472 - Advanced Topics in Computer Security

This course covers various aspects of producing trusted computer information systems. Topics include network perimeter protection, host-level protection, authentication technologies, formal analysis techniques, and intrusion detection. Current systems will be examined and critiqued.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): (CS 4471 or CS 5471)

CS 5481 - Systems Performance Analysis

Analysis of the performance of computer systems. Topics include: measurement techniques and tools, probability theory and statistics, experiment design and analysis, simulation, queuing models. Course includes a significant experimental component.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring

Pre-Requisite(s): CS 4411 and MA 2720

CS 5491 - Cloud Computing

Overview of the principles, methods, and leading technologies of cloud computing. Topics include cloud computing concepts: Hadoop, MapReduce; Software as a Service (SaaS); Platform as a Service (PaaS); Infrastructure as a Service (IaaS); workload patterns and resource management; migrating to the cloud; and case studies. Students will build their own cloud application using Amazon or IBM cloud services.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Pre-Requisite(s): CS 3425

CS 5495 - 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: (0-3-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): CS 3411 and CS 3421

CS 5496 - GPU and Multicore Programming

Introduction to Graphics Processing units (GPU) and multi-core systems, their architectural features and programming models, stream programming and compute unified driver architecture (CUDA), caching architectures, linear and non-linear programming, scientific computing on GPUs, sorting and search, stream mining, cryptography, and fixed and floating point operations.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): CS 3411 and CS 3421

CS 5497 - Multimedia Data Security in Hardware Firmware and Software

Software and hardware aspects of digital media security, data protection; Analysis of digital media for purposes of authentication and protection against tampering and forgery; Electronic tamper detection; Secure exchange of digital content over the Internet or electronic media; Cryptographic processors.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Pre-Requisite(s): CS 4321

CS 5611 - Computer Graphics: Advanced Rendering and Modeling

Topics include polygonal objects, lighting models, shadows and textures, ray-tracing, radiosity, photon mapping, parametric curves and surfaces, meshes, and mesh modeling.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Pre-Requisite(s): CS 4611

CS 5631 - Data Visualization

Introduction to scientific and information visualization. Topics include methods for visualizing three-dimensional scalar and vector fields, visual data representations, tree and graph visualization, large-scale data analysis and visualization, and interface design and interaction techniques.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring

Pre-Requisite(s): CS 4611 or CS 5611

CS 5641 - Immersive Virtual Environments

An introduction to immersive virtual environment technologies and their applications. Topics include: wall-sized displays, head-mounted displays, 3D displays, orientation and position tracking, human perception, and recent research utilizing virtual reality systems.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Pre-Requisite(s): CS 4611(C)

CS 5740 - Development of Trusted Software

This course exposes students to the concepts of secure software development. Students will learn how to develop high-quality software that is resistant against cyber-attacks, by minimizing the number of vulnerabilities that can be exploited by an attacker. Topics include: access control, race conditions, buffer overflows, code injection, fuzzing techniques, cryptographic software, web application and Java security.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring

Pre-Requisite(s): CS 4471

CS 5760 - Human-Computer Interactions and Usability Testing

Current issues in human-computer interaction (HCI), evaluation of user interface (UI) design, and usability testing of UI. Course requires documenting UI design evaluation, UI testing, and writing and presenting a HCI survey, concept or topic paper.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Pre-Requisite(s): CS 4760

CS 5761 - Human-Robot Interaction

This course covers topics, such as anthropomorphism and embodiment, dialogue, emotion, human-robot team interaction, assistive robots, ethical issues, and measurement and evaluation.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand

CS 5770 - Affective Design and Computing

An examination of emotions and affect in Human Factors and HCI. Topics may include brain and cognitive mechanisms and methods/techniques, affective computing, Kansei engineering, hedonomics, emotional design, and application domains.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand

CS 5811 - Advanced Artificial Intelligence

Course topics include current topics in artificial intelligence including agent-based systems, learning, planning, use of uncertainty in problem solving, reasoning, and belief systems.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Pre-Requisite(s): CS 4811

CS 5821 - Computational Intelligence - Theory and Application

This course covers the four main paradigms of Computational Intelligence, viz., fuzzy systems, artificial neural networks, evolutionary computing, and swarm intelligence, and their integration to develop hybrid systems. Applications of Computational Intelligence include classification, regression, clustering, controls, robotics, etc.

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 Level(s): Graduate

CS 5831 - Advanced Data Mining

Data mining focuses on extracting knowledge from large data sources. The course covers data mining concepts, methodology (measurement, evaluation, visualization), algorithms (classification/regression, clustering, association rules) and applications (web mining, recommender systems, bioinformatics).

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): (CS 3425 or MIS 3100) and (MA 2330 or MA 2320 or MA 2321) and (MA 2710 or MA 2720 or MA 3710)

CS 5841 - Machine Learning

This course will explore the foundational techniques of machine learning. Topics are pulled from the areas of unsupervised and supervised learning. Specific methods covered include naive Bayes, decision trees, support vector machine (SVMs), ensemble, and clustering methods.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

Pre-Requisite(s): CS 4821

CS 5990 - Master's Research in Computer Science

The study of an acceptable computer science problem and the preparation of a thesis

Credits: variable to 9.0; May be repeated; Graded Pass/Fail Only

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

CS 5994 - International Computer Science Field Experience

Field work and reporting from students in the Peace Corps Master's International Program in Computer Science.

Credits: 1.0; May be repeated

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Computer Science

CS 5999 - Master's Reading and Research in Computer Science

Individual reading and research on current topics in computer science.

Credits: variable to 9.0; May be repeated

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

CS 6090 - Special Topics in Computer Science

Special topics in Computer Science offered on occasion based on student and faculty demand and interest.

Credits: variable to 4.0; May be repeated

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of department required

CS 6091 - Doctoral Seminar in Computer Science

Seminar covers advanced topics in current Computer Science research for doctoral degree candidates. Offered according to student demand.

Credits: variable to 3.0; May be repeated

Semesters Offered: On Demand

Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

CS 6990 - Doctoral Research in Computer Science

The study of an acceptable computer science problem and the preparation of a dissertation.

Credits: variable to 9.0; May be repeated; Graded Pass/Fail Only

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

CS 6999 - Doctoral Reading and Research in Computer Science

Individual reading and research on current topics in Computer Science for doctoral degree candidates.

Credits: variable to 9.0; May be repeated

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

Computational Science & Engineering**CSE 5091 - Computational Science and Engineering Seminar**

From time to time, depending on student demand, a seminar will be offered on current topics in computational science and engineering.

Credits: variable to 3.0; May be repeated

Semesters Offered: Fall, Spring

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

CSE 5311 - Theory of Computation

Topics covered include Turing machines and their variants, the halting problem and decidability, computability, reducibility, NP-completeness, time and space complexity, and topics from recursive function theory. The course starts with a brief review of the computation models from CS3311.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): CS 3311

CSE 5321 - Advanced Algorithms

Topics include algorithms for complex data structures, amortized analysis, and NP-completeness. Application areas include approximation algorithms, network flow, combinatorics, string matching, and parallel algorithms. Additional topics as time permits.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): CS 4321

CSE 5331 - Parallel Algorithms

Emphasizes the principles used in the development of algorithms for parallel computers, including programming paradigms, implementation, analysis, and performance evaluation. Considers algorithms in the areas of scientific computation and nonnumeric processing as well as software tools for performance visualization and debugging.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): CS 4321 and CS 4431

CSE 5710 - Modeling and Simulation Applications for Decision-Making in Complex Dynamic Domains

Introduces students to the theory and application of modeling techniques and simulations in the analysis of decision alternatives. Topics include queuing theory, system dynamics modeling, agent based modeling, and discrete event simulation. Students conceptualize and implement an appropriate research/engineering problem of choice (this could be a dissertation/thesis problem).

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

CSE 5720 - Descriptive Modeling of Data using Statistical and Graphical Methods

Focuses on the fundamentals of probability theory and graph theory and how relevant concepts apply to describe, model, and analyze data sets. Topics include probability distributions, Bayes theorem, conditional independence, discrete and continuous models, regression models, hypothesis testing, and Markov chain methods.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

CSE 5811 - Advanced Artificial Intelligence

Current topics in artificial intelligence including agent-based systems, learning, planning, use of uncertainty in problem solving, reasoning, and belief systems.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Pre-Requisite(s): CS 4811

CSE 6090 - Special Topics in Computational Science and Engineering

Special topics in Computational Science and Engineering offered on occasion based on student and faculty demand and interest.

Credits: variable to 4.0; May be repeated

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of department required

CSE 6091 - Computational Science and Engineering Seminar

From time to time, depending on student demand, a seminar will be offered on current topics in computational science and engineering.

Credits: variable to 3.0; May be repeated

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

CSE 6990 - Doctoral Research

By arrangement with the instructor directing the PhD dissertation.

Credits: variable to 9.0; May be repeated; Graded Pass/Fail Only

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

CSE 6999 - Doctoral Reading and Research

Individual reading and research on current topics in computational science and engineering.

Credits: variable to 9.0; May be repeated

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

Economics**EC 5000 - Microeconomic Theory**

The study of consumer and producer choices, market demand and supply, and market structures. Not open to students with credit for EC3002.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

EC 5010 - Macroeconomics

The study of the determinants of the level of income, employment, the rate of inflation, economic growth, and cyclical variations in the economy, including considerations of the rationale for monetary and fiscal policy and their impact on the business community.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): EC 3003

EC 5300 - Managerial Economics

Economic analysis of the operation of a business. Topics include optimization, demand theory and forecasting, production/cost analysis, market structure and strategic behavior, risk analysis, antitrust policy and regulation of safety and the environment, and international management.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Business Administration, Applied Natural Resource Econ., Accounting

EC 5400 - Advanced Engineering Economics

Presents and demonstrates procedures and quantitative techniques used in capital budgeting and project evaluation and selection for industry. Topics include cash flow analysis, decision methods, risk and uncertainty, cost of capital, taxes and depreciation, and forecasting market variables. Topics presented with study problems, applying spreadsheet programs.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand - Offered alternate years beginning with the

2002-2003 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): EC 3400

EC 5620 - 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. Research project applies economic analysis to supply, distribution, and use of energy resources, including environmental and social consequences.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

EC 5630 - Mineral Industry Economics

Analyzes the economic aspects of the production/use of minerals in society. Uses economic analysis to explain behavior and policy implications for issues of supply, demand, markets, and foreign trade for important minerals. Analyzes the impact of government policies on the minerals industries.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

EC 5640 - Natural Resource Economics

Analyzes the economic aspects of producing/using natural resources. Nonrenewable resources and renewable resources are discussed. The economics of land use, macroeconomic topics such as economic growth, sustainability and green accounting are considered.

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): EC 2001 or EC 3002

EC 5650 - Environmental Economics

Considers the efficient and equitable use of environmental resources. Measures the benefits and costs of decreasing pollution and protecting scarce ecological resources; addresses market failures and the economic valuation of environmental amenities. Requires students to learn quantitative and technical techniques to determine the efficient use of resources.

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): EC 2001 or EC 3002

EC 5900 - Special Topics

Economic topics of interest to students or independent study in economics under the guidance of a faculty member.

Credits: variable to 4.0; Repeatable to a Max of 8

Semesters Offered: On Demand

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

EC 5994 - Field Work in Applied Natural Resource Economics

Field work and reporting from students in the Peace Corps Master's International Program in applied natural resource economics.

Credits: 1.0; May be repeated

Lec-Rec-Lab: (0-1-0)

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

EC 5999 - Graduate Research

Under the guidance of a faculty member, students will read, conduct research, and prepare a report, paper, or thesis.

Credits: variable to 15.0; May be repeated; Graded Pass/Fail Only

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Education

ED 0510 - Graduate Teaching Assistant Training

Half semester course for training graduate teaching assistants (GTAs). Covers course preparation, educational testing and evaluation, instructional strategies (discussions, lecturing, collaborative learning, cases/simulations, etc.), using instructional technologies, motivating students, and institutional resources.

Credits: 1.0

Lec-Rec-Lab: (0-2-0)

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

ED 5100 - College Teaching

Focuses on instructional planning, delivery, and assessment in a higher education context. Students learn to write objectives, apply backward design, create objective-linked high-engagement classroom activities, and assess student learning. Additional topics include course syllabi, teaching portfolios, and teaching philosophy statements.

Credits: 1.0

Lec-Rec-Lab: (0-2-0)

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Co-Requisite(s): ED 0510

ED 5101 - Foundations of Online Teaching

This course provides an introduction to the planning, design development, and delivery of an online course. Students learn to create measurable learning objectives, engaging online activities, and authentic assessments for use in a future online course. Students will create and deliver an online lesson as their course capstone.

Credits: 1.0

Lec-Rec-Lab: (0-1-0)

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

ED 5110 - Psychological Foundations of Education

The course examines how human beings grow and learn across the lifespan. Psychological basis of educational procedures and practices are established with special reference to formal schooling, higher and tertiary education, and workplace settings.

Credits: 2.0

Lec-Rec-Lab: (0-2-0)

Semesters Offered: On Demand

Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

ED 5300 - 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. Students will engage in analysis of technology-integrating teaching methods.

Credits: 2.0

Lec-Rec-Lab: (0-2-0)

Semesters Offered: On Demand

Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

Co-Requisite(s): ED 4700

ED 5540 - Special Topics in Education

Group studies of specially selected issues or problems in education.

Credits: variable to 6.0; Repeatable to a Max of 9

Semesters Offered: On Demand

Restrictions: Permission of instructor required

ED 5560 - Ecology of Isle Royale for Educators

K-12 teachers participate in a field-based camping experience on Isle Royale National Park, exploring basic ecological concepts regarding the interrelatedness of plants, animals, geology, climate, and human influences on Isle Royale. Prepares teachers to help students understand interrelationships, energy distribution in ecosystems and change over time.

Credits: variable to 3.0

Semesters Offered: On Demand

Restrictions: Permission of department required

ED 5562 - Isle Royale Special Studies for Educators

Field course for K-12 teachers to explore specific aspects of the Isle Royale environment with emphasis on integration of the experience into the science classroom.

Credits: variable to 3.0; Repeatable to a Max of 6

Semesters Offered: On Demand

Restrictions: Permission of department required

ED 5570 - Lesson Study

Teachers will engage in an intensive method of improving instruction that includes designing a lesson with a group of colleagues, implementing the lesson in one of their classrooms, and collectively examining the lesson's effectiveness in engaging students in meaningful learning.

Credits: variable to 3.0; Repeatable to a Max of 3

Semesters Offered: On Demand

Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

ED 5581 - Teaching and Communicating Scientific Research

Discussion of practical aspects of implementing inquiry-based instruction, communicating science and scientific research to the public, and educational resources for science teaching.

Credits: 1.0; Repeatable to a Max of 6

Lec-Rec-Lab: (0-1-0)

Semesters Offered: On Demand

Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

ED 5590 - Developing Science, Technology, Engineering and Mathematics (STEM) Instruction

Exploration of foundational theories of STEM education. Students will participate in engineering-integrated learning activities, engage in inquiry-based learning tasks in mathematics and science, and utilize technology to enhance student learning. Students will practice backwards design to develop their own STEM learning activity.

Credits: 2.0; Repeatable to a Max of 4

Lec-Rec-Lab: (2-0-0)

Semesters Offered: On Demand

Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

ED 5600 - Independent Study in Education

Through an independent study, gain additional insights to relevant topics in education and research. Students must work directly with select faculty to develop a structured line of study on select educational topics.

Credits: variable to 6.0; Repeatable to a Max of 9

Semesters Offered: On Demand

Restrictions: Permission of instructor required

ED 5601 - Special Content Studies in Education

Intensive institutes designed to help elementary, middle and high school educators integrate important concepts in math and science into classroom teaching units.

Credits: variable to 9.0; Repeatable to a Max of 9

Semesters Offered: On Demand

Restrictions: Permission of department required

ED 5602 - Special Applications in Education

Practical application following special content studies during which elementary, middle and high school teachers implement and evaluate a teaching unit that they designed for their own classroom inspired by the previous content course. A mandatory teachers' forum provides opportunity to share ideas with other participating teachers.

Credits: variable to 9.0; Repeatable to a Max of 9

Semesters Offered: On Demand

Restrictions: Permission of department required

ED 5620 - Professional Development for Educators: Teaching Earth Science

A course for the professional development of professional K-12 educators.

Topics address ideas, trends, and applications in the teaching and learning of earth science.

Credits: variable to 4.0; Repeatable to a Max of 12

Semesters Offered: On Demand

Restrictions: Permission of department required; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

ED 5630 - Professional Development for Educators: Teaching Life Sciences

A course for the professional development of professional K-12 educators.

Topics address ideas, trends, and applications in the teaching and learning of life science.

Credits: variable to 4.0; Repeatable to a Max of 12

Semesters Offered: On Demand

Restrictions: Permission of department required; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

ED 5640 - Professional Development for Educators: Teaching Environmental Science

A course for the professional development of professional K-12 educators.

Topics address ideas, trends, and applications in the teaching and learning of environmental science.

Credits: variable to 4.0; Repeatable to a Max of 12

Semesters Offered: On Demand

Restrictions: Permission of department required; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

ED 5641 - Global Change Institute for Teachers

This course will provide teachers with the skills necessary to engage middle/high school students in real-world study of global climate change and its effects on ecosystems. National Content Standards for mathematics, and life, earth, and physical sciences will be addressed.

Credits: variable to 4.0; Repeatable to a Max of 4

Semesters Offered: On Demand

Restrictions: Permission of department required

ED 5650 - Professional Development for Educators: Teaching Physical Science

A course for the professional development of professional K-12 educators.

Topics address ideas, trends, and applications in the teaching and learning of physical science.

Credits: variable to 4.0; Repeatable to a Max of 12

Semesters Offered: On Demand

Restrictions: Permission of department required; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

ED 5660 - Professional Development for Educators: Teaching Mathematics

A course for the professional development of professional K-12 educators.

Topics address ideas, trends, and applications in the teaching and learning of mathematics.

Credits: variable to 4.0; Repeatable to a Max of 12

Semesters Offered: On Demand

Restrictions: Permission of department required; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

ED 5665 - Professional Development for Educators: Teaching Computer Science

A course for the professional development of professional K-12 educators.

Topics address ideas, trends, and applications in the teaching and learning of computer science.

Credits: variable to 4.0; Repeatable to a Max of 12

Semesters Offered: On Demand

Restrictions: Permission of department required; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

ED 5670 - Teaching Technologies for Educators

This course guides educators in using technologies to design, implement, and assess learning experiences. Outcomes include the development of strategies to engage students, improve learning, and enrich professional practice through the thoughtful integration of technology.

Credits: variable to 4.0; Repeatable to a Max of 12

Semesters Offered: On Demand

Restrictions: Permission of department required; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

ED 5680 - Professional Development for Educators: Teaching Social Studies

A course for the professional development of professional K-12 educators.

Topics address ideas, trends, and applications in the teaching and learning of social studies.

Credits: variable to 4.0; Repeatable to a Max of 12

Semesters Offered: On Demand

Restrictions: Permission of department required; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

ED 5690 - Professional Development for Educators: Teaching Language Arts

A course for the professional development of professional K-12 educators.

Topics address ideas, trends, and applications in the teaching and learning of language arts.

Credits: variable to 4.0; Repeatable to a Max of 12

Semesters Offered: On Demand

Restrictions: Permission of department required; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

ED 5700 - Introduction to Education Research

Overview of education research methods to develop an understanding of designing education research, including the relationship between research question, theoretical framework(s), and methods. Focus is placed on developing a literature review to help lay theoretical groundwork for pursuing education research.

Credits: 2.0

Lec-Rec-Lab: (0-2-0)

Semesters Offered: On Demand

Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

ED 5703 - Action Research in Depth

A web-based study of education research methods linking classroom practice, curriculum standards, and program evaluation with research about learning. Teachers will learn about data presentation, action learning, and developing students into communities of science learners.

Credits: 2.0

Lec-Rec-Lab: (0-2-0)

Semesters Offered: On Demand

Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

ED 5705 - Action Research Project

Teachers will engage in the systematic study of their own practice by designing an action research study and then collecting and analyzing data to answer a question about their own teaching and/or student learning. Course enrollment is restricted to practicing teachers.

Credits: variable to 4.0; Repeatable to a Max of 8

Semesters Offered: On Demand

Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

ED 5720 - Inquiry-Based practices for Science and Mathematics Teaching

Examination of science and mathematics inquiry-based teaching practices and learning materials that support student understanding and engagement, and align to state and national standards.

Credits: 2.0

Lec-Rec-Lab: (2-0-0)

Semesters Offered: On Demand

Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

ED 5730 - Assessment and Evaluation

Methodological perspectives and techniques for assessing and evaluating student learning to inform instructional decision making.

Credits: 2.0

Lec-Rec-Lab: (0-2-0)

Semesters Offered: On Demand

Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

ED 5740 - Designing Education Research

Course focuses on designing a research project for the MSASE program. Emphasis on motivating a study, developing research questions, conducting a literature review, and selecting appropriate research methodology. Should be taken within one year of beginning research project.

Credits: 2.0

Lec-Rec-Lab: (0-2-0)

Semesters Offered: On Demand

Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): ED 5700

ED 5750 - Diagnosis and Remediation of Reading Problems

Identification of problems related to reading and language processing; identification and application of diagnostic, remediation and assessment strategies and instruments. Classroom specific experience in diagnosis and remediation of the total communication process.

Credits: 3.0

Lec-Rec-Lab: (0-2-2)

Semesters Offered: On Demand

Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

ED 5780 - Intro to Qualitative Research

An introduction to the use of qualitative research methods in social science contexts. Emphasis is placed on understanding the underpinnings of qualitative research, research traditions, and theoretical orientations. Students will be introduced to specific qualitative analysis techniques, ways to interpret data, and writing strategies.

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 Level(s): Graduate

ED 5800 - Applied Internship for Educators

Students will work in an industry or on a research project. At the conclusion of the internship, students will write a paper regarding how they will apply what they have learned in their pre-college classroom or in their own research.

Credits: variable to 6.0; Repeatable to a Max of 6

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

Co-Requisite(s): ENG 5100

ED 5820 - Advanced Methods of Teaching Science

Application of learning and instructional theories to the teaching of science. Emphasizes methods of materials used to teach early adolescents. Taught from the perspective of science teachers. Lab offers opportunities to refine instructional techniques. K-12 science classroom teaching experience required.

Credits: 2.0; Repeatable to a Max of 4

Lec-Rec-Lab: (1-0-2)

Semesters Offered: On Demand

Restrictions: Permission of department required

ED 5860 - STEM Education Practicum

Practical experience in teaching, education research, and/or assessment in a STEM discipline. Students either teach/mentor undergraduate STEM students, work with a faculty member on a STEM education research project or work with STEM assessment activities. A seminar is required.

Credits: variable to 5.0; Repeatable to a Max of 5

Semesters Offered: On Demand

Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): ED 5100 and ED 5110 and ED 5700

ED 5900 - Graduate Research in Education

Students will conduct a research project/report as a capstone to an approved plan of study. The student should present a project plan to their education advisor for approval, conduct whatever work is necessary for the project, prepare a final report at the conclusion of the project, and defend the project/report in an oral presentation.

Credits: variable to 6.0; Repeatable to a Max of 6; Graded Pass/Fail Only

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor and department required; Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): ED 5700

ED 5910 - Teaching Internship

Knowledge of human growth and learning theories, methods and materials, and individual differences applied to classroom settings, conducted under the supervision of an experienced middle or secondary school teacher. Completion of MTTC Basic Skills Test. See department for application deadlines.

Credits: 12.0

Lec-Rec-Lab: (0-0-36)

Semesters Offered: On Demand

Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): ED 5110 and ED 5210 and ED 5410

ED 5920 - Teaching Internship - Preparation for International Teaching

Application of learning theory, including individual differences and content specific pedagogy, in a classroom setting, conducted under supervision of an experienced secondary teacher. Preparation for placement in teaching position with the Peace Corps. Requires completion of MTTC Basic Skills Test.

Credits: variable to 6.0

Semesters Offered: On Demand

Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): ED 4720 or ED 5820

ED 5921 - International Teaching Internship

Application of learning theory, including individual differences and content specific pedagogy, in an international classroom through Peace Corps service. Internship is conducted under the supervision of an experienced secondary teacher. Requires completion of MTTC Basic Skills Test.

Credits: 1.0; Repeatable to a Max of 18

Lec-Rec-Lab: (0-1-0)

Semesters Offered: On Demand

Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): ED 4720 or ED 5820

ED 5994 - Field Work in International Science Education

Field work and reporting from students in the Peace Corps Master's International Program in Science Education.

Credits: 1.0; Repeatable to a Max of 18

Lec-Rec-Lab: (0-1-0)

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

Electrical & Computer Engineering**EE 5200 - Advanced Methods in Power Systems**

Advanced analysis and simulation methods for load flow, symmetrical components, short circuit studies, optimal system operation, stability, and transient analysis. Application of commonly used software reinforces concepts and provides practical insights.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Electrical Engineering, Electrical Engineering; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

Pre-Requisite(s): EE 4222

EE 5220 - Transient Analysis Methods

A study of transient behaviors and their analysis and prediction. Addresses analytical methods and their numerical implementation, switching and lightning surges, short circuits, and non-linear effects. Includes computer simulations.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2007-2008 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Electrical Engineering, Electrical Engineering; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

Pre-Requisite(s): EE 4222

EE 5221 - Advanced Electric Machinery and Drives

Advanced electromechanics of rotating and linear machines. Topics include dynamic analysis of machines, reference frame transformations, reduced order models, models of mechanical loads, power electric drives for motors, and digital simulation of machines and electric drive systems. Applications discussed will include renewable energy and electric propulsion systems.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2013-2014 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

EE 5223 - 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

EE 5224 - 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 5223(C)

EE 5227 - Advanced Power Electronics

Advanced topics 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, classical feedback control, nonlinear control, magnetic components, power semiconductors, and digital simulation.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2012-2013 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): EE 4227

EE 5230 - Power System Operations

Study of advanced engineering and economic algorithms and analysis techniques for the planning, operation, and control of the electric power system from generation through transmission to distribution.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Electrical Engineering, Electrical Engineering

EE 5231 - Energy Control Center Applications

Monitoring and control technologies for control centers that govern electrical power transmission systems. Topics include study of historical power blackouts, state estimation, alarm processing, fault diagnosis, telecommunication assessment, defense strategies, system-wide restoration, and visualization.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand

Restrictions: Permission of instructor required

Pre-Requisite(s): EE 3120

EE 5232 - Power System Optimization

Linear, non-linear, and integer programming, simplex method, branch and bound, steepest descent method, convex, stochastic, and distributed optimization, interior-point method, evolutionary algorithm, optimal power flow, unit commitment, vot/var optimization, state estimation, feeder reconfiguration.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2017-2018 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

EE 5240 - Computer Modeling of Power Systems

Topics include modeling and computer methods applied to electrical power systems, matrix formulations, network topology and sparse matrix data structures, loadflow, short-circuit and stability formulations, constrained optimization methods for loadflow and state estimation, and time-domain simulation methods for transient analysis.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2008-2009 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Electrical Engineering

Pre-Requisite(s): EE 5200

EE 5250 - Distribution Engineering

Modeling and analysis of electrical distribution systems; load characteristics, load modeling, unbalanced three-phase overhead and underground line models, and distribution transformers. Analysis of 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 2007-2008 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): EE 4221

EE 5251 - Distribution Engineering II

Course covers fundamentals of feeded reconfiguration for distribution systems. The unbalanced three-phase power flow will be used throughout the course for fault location, fault isolation and service restoration, outage management for crew coordination, trouble tickets, and switching procedure management.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

EE 5260 - Wind Power

Wind turbines are the fastest growing segment of the generator mix being added to power systems today. There is a growing need to understand the many issues caused by these additions. This course covers the theoretical background, regulations, integration experience, and modeling.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

EE 5275 - Energy Storage Systems

Designing energy storage solutions for grid, vehicle and portable/autonomous systems. Quantitative and qualitative analysis of energy storage aging, cost, and performance improvement.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

EE 5290 - Selected Topics in Power Systems 1

Selected topics of current interest.

Credits: variable to 4.0; May be repeated

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Electrical Engineering, Electrical Engineering

EE 5295 - Advanced Propulsion Systems for Hybrid Electric Drive Vehicles

Hybrid electric vehicles (HEV) will be studied and simulated using advanced powertrain component analysis and modeling. An in-depth analysis and study of power flows, losses, and energy usage are examined for isolated powertrain components and HEV configurations. Simulation tools will be developed and applied to specify powertrain and vehicle components and to develop control and calibration for a constrained optimization to vehicle technical specifications.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following College(s): College of Engineering

Pre-Requisite(s): MEEM 4295 or EE 4295

EE 5296 - Powertrain Integration in HEV

This hands-on course examines challenges with powertrain integration in Hybrid Vehicles. Topics include Vehicle Development Process, Thermal Management, Vehicle Controls, Safety, Calibration, and Vehicle Simulation Models. The course project includes optimizing performance of a configurable HEV using modeling and experimentation.

Credits: 3.0

Lec-Rec-Lab: (0-2-2)

Semesters Offered: Spring, Summer

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following College(s): College of Engineering

Pre-Requisite(s): MEEM 4296(C) or EE 4296(C)

EE 5300 - Mathematical and Computational Methods in Engineering

Overview of problem-solving tools and techniques in engineering, considered from both the analytical and computational point of view. Systems of linear equations, eigenvalue and eigenvector computations, boundary value and initial value problems, Fourier analysis, large-scale systems, optimization. Mathematical modeling and computer programming.

Credits: 3.0
 Lec-Rec-Lab: (3-0-0)
 Semesters Offered: Fall, Spring
 Restrictions: Must be enrolled in one of the following Major(s): Electrical Engineering, Computer Engineering; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

EE 5315 - Cyber Security of Automotive Systems I

Modern automotive control and communications systems from a cyber security perspective. Topics include: V2X communications, vehicle attack surfaces and vulnerabilities, in-vehicle networks, threat analysis and vulnerabilities, security mechanisms and architectures, security requirements analysis, hardware security modules, and standards.

Credits: 3.0
 Lec-Rec-Lab: (0-3-0)
 Semesters Offered: Spring
 Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Computer Science, Mechanical Engineering, Mechanical Eng-Eng Mechanics, Computer Engineering, Electrical Engineering
 Pre-Requisite(s): MEEM 5300 or EE 5455

EE 5365 - In-Vehicle Communication Networks

Course focuses on in-vehicle system domains and their requirements, and in-vehicle communication bus Controller Area Network (CAN) and its related physical layers standards. It also covers other buses such as LIN, FlexRay, MOST, Ethernet, as well as introduction to V2V and V2I.

Credits: 3.0
 Lec-Rec-Lab: (2-0-3)
 Semesters Offered: Fall, Summer
 Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Computer Science, Engineering Mechanics, Mechanical Engineering, Computer Engineering, Electrical Engineering
 Pre-Requisite(s): EE 3250

EE 5367 - Vehicular Networking

Theories/principles, technologies, standards and applications of vehicular ad-hoc networks (VANET), as well as design considerations and main challenges to implement inter-vehicular communication networks. Topics include vehicle mobility modeling, physical layer considerations, routing protocols, and data security. Requires Linux OS, Python or C++.

Credits: 3.0
 Lec-Rec-Lab: (2-0-3)
 Semesters Offered: Spring
 Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Computer Science, Engineering Mechanics, Mechanical Engineering, Computer Engineering, Electrical Engineering
 Pre-Requisite(s): EE 5365 and EE 4272

EE 5373 - Advanced Programmable Controllers

Using Allen Bradley Contr Logix and SLC500 programmable controllers, course covers structured programming, Sequential Function Charts, networking, proportional integral differential control, data acquisition and interfacing. The course requires proposing, executing, and defending at the graduate level related to the course material project.

Credits: 4.0
 Lec-Rec-Lab: (0-2-3)
 Semesters Offered: Spring
 Pre-Requisite(s): EE 3373

EE 5390 - Scientific Computing

Set in a Linux environment, course offers exposure to Foss tools for developing computational and visualization workflows. Students will learn to translate problems into programs, understand sources of errors, and debug, improve the performance of and parallelize the code.

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; Must be enrolled in one of the following Major(s): Electrical Engineering, Computer Engineering

EE 5410 - Engineering Electromagnetics

A mathematically rigorous study of dynamic electromagnetic fields, beginning with Maxwell's equations. Topics include scalar and vector potentials, waves, and radiation.

Credits: 3.0
 Lec-Rec-Lab: (3-0-0)
 Semesters Offered: Fall
 Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Electrical Engineering, Electrical Engineering
 Pre-Requisite(s): EE 3140

EE 5415 - Applied Optics and Photonics

Rigorous study of nonlinear optics, anisotropic, optical materials, dielectric waveguides, directional couplers, semiconductor optics, light sources, lasers, and photodetectors.

Credits: 3.0
 Lec-Rec-Lab: (3-0-0)
 Semesters Offered: Spring
 Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior
 Pre-Requisite(s): EE 3090 or PH 3210 or EE 4411

EE 5430 - Electronic Materials

A study of the physical principles, operational characteristics, models, and basic applications of selected solid-state devices.

Credits: 3.0
 Lec-Rec-Lab: (3-0-0)
 Semesters Offered: Fall
 Restrictions: Must be enrolled in one of the following Level(s): Graduate

EE 5451 - Risk Assessment for Critical Infrastructure Protection

Risk assessment and vulnerabilities for industrial control environments including electrical power grids. Cyber-physical attack tools and techniques. Interaction of cybersecurity issues with physical systems and physical security. Limitations of current cybersecurity technologies. Design and cost considerations for various defensive methods.

Credits: 3.0
 Lec-Rec-Lab: (3-0-0)
 Semesters Offered: Spring
 Restrictions: Permission of instructor required
 Pre-Requisite(s): EE 3120

EE 5455 - Cybersecurity of Industrial Control Systems

General introduction to cybersecurity of industrial control systems and critical infrastructures. Topics include NIST and DHS publications, threat analysis, vulnerability analysis, red teaming, intrusion detection systems, industrial networks, industrial malware, and selected case studies.

Credits: 3.0
 Lec-Rec-Lab: (0-3-0)
 Semesters Offered: On Demand
 Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Electrical Engineering, Computer Science, Computer Engineering

EE 5460 - Solid State Devices

A study of the physical principles, operational characteristics and models and basic applications of solid state devices such as p-n junctions, metal-semiconductor junctions and transistors.

Credits: 3.0
 Lec-Rec-Lab: (3-0-0)
 Semesters Offered: Spring
 Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

EE 5461 - Mobile Networks

This course will explore the Mobile network issues including routing and mobility management strategies in ad hoc networks, sensor networks, and personal area networks such as Bluetooth.

Credits: 3.0
 Lec-Rec-Lab: (3-0-0)
 Semesters Offered: Spring, Summer
 Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior
 Pre-Requisite(s): EE 4272 or CS 4461

EE 5470 - Semiconductor Fabrication

Graduate level introduction to the science and engineering of semiconductor device fabrication.

Credits: 3.0
 Lec-Rec-Lab: (3-0-0)
 Semesters Offered: Fall
 Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

EE 5471 - Microfabrication Laboratory

A hands-on laboratory experience in which the students fabricate devices with micro-and nano- scale dimensions. Lecture component covers safety training, background on microfabrication processes and systems, and facility tours to observe additional systems.

Credits: 2.0
 Lec-Rec-Lab: (1-0-3)
 Semesters Offered: Fall, Spring
 Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

EE 5480 - Advanced MEMS

This course will cover advanced topics dealing with MEIXIS technologies, transduction mechanisms, and microfabricated sensors and actuators and is a continuation of EE4240/MY4240

Credits: 4.0

Lec-Rec-Lab: (3-1-0)

Semesters Offered: Spring

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

Pre-Requisite(s): EE 4240 or MY 4240

EE 5490 - Solar Photovoltaic Science and Engineering

Solar photovoltaic materials, the device physics of photovoltaic cells and practical applications of solar electric systems engineering.

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 Level(s): Graduate

EE 5496 - GPU and Multicore Programming

Introduction to Graphics Processing Units (GPU) and multi-cores, their architectural features and programming models, stream programming, and compute unified driver architecture (CUDA), caching architectures, linear and non-linear programming, scientific computing on GPUs, sorting and search, stream mining, cryptography, and fixed and floating point operations.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): CS 3411 and EE 4173

EE 5497 - Multimedia Data Security in Hardware Firmware and Software

Software and hardware aspects of digital media security, data protection; Analysis of digital media for purposes of authentication and protection against tampering and forgery; Electronic tamper detection; Secure exchange of digital content over the Internet or electronic media; Cryptographic processors.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): CS 4321

EE 5500 - Probability and Stochastic Processes

Theory of probability, random variables, and stochastic processes, with applications in electrical and computer engineering. Probability measure and probability spaces. Random variables, distributions, expectations. Random vectors and sequences. Stochastic processes, including Gaussian and Poisson processes. Stochastic processes in linear systems. Markov chains and related topics.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Major(s): Electrical Engineering, Electrical Engineering; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

EE 5511 - Information Theory

Mathematical models for channels and sources; entropy, information, data compression, channel capacity, Shannon's theorems, and rate-distortion theory.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2007-2008 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): EE 5500

EE 5520 - Fourier Optics

Analysis and modeling of diffraction effects on optical systems, emphasizing frequency-domain analytic and computational approaches. Presents wave propagation, imaging, and optical information processing applications.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Electrical Engineering, Electrical Engineering

Pre-Requisite(s): EE 3190

EE 5521 - Detection & Estimation Theory

Detecting and estimating signals in the presence of noise. Optimal receiver design. Applications in communications, signal processing, and radar.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Electrical Engineering, Computer Engineering

Pre-Requisite(s): EE 5500

EE 5522 - Digital Image Processing

Fundamentals of image processing are covered including image representation, geometric transformations, binary image processing, compression, space and frequency domain processing. Computer programming in MATLAB and Python required.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Electrical Engineering, Computer Engineering

EE 5525 - Wireless Communications

Principles of wireless communications systems. Projects may include cell phones, computer networks, paging systems, satellite communications, radio, television and telemetry.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): EE 5527

EE 5526 - Microwave Engineering

Basics of microwave engineering. Topics include: microwave sources; wave equations and their solutions; wave propagation; reflection, and guiding; transmission line theory and practice; microwave network analysis and impedance matching; microwave resonators, filters, and dividers; left-handed materials and devices.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): EE 3140 or EE 5140

EE 5527 - Digital Communications

This course focuses on the basic principles that underlie the analysis and design of digital communication systems. Topics covered include: characterization of communication signals and systems, modulation schemes, optimum receiver design and performance analysis in AWGN and band-limited channels, concepts of information theory and channel coding, carrier and symbol synchronization, and ISI channel equalization.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): EE 3250

EE 5528 - Antenna Engineering

Topics include: basics of radiation theory, Hertzian dipole and loop antennas, near and far fields, bandwidth, gain and other antenna parameters, Yagi-Uda, bow-tie, cavity-backed and traveling wave antennas, microstrip solutions, miniaturization, substrates and superstrates.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2013-2014 academic year

Pre-Requisite(s): EE 5526

EE 5531 - Introduction to Robotics

Introduction to autonomous systems and robotics with focus on automated ground vehicles. Project based course using distributed computing to solve problems related to motion planning, perception, and localization. Requires experience with Linux operating systems variants, version control systems, and C++ or Python.

Credits: 3.0

Lec-Rec-Lab: (2-0-3)

Semesters Offered: Spring

Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following College(s): College of Engineering

EE 5532 - Sensing and Processing for Robotics

Sensing modes, signal and image processing for industrial robotic automation processes. Emphasis placed on widely used sensors, including cameras and 3-D sensors for process control and computer vision for autonomous navigation.

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, Computer Engineering; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

Pre-Requisite(s): EE 5522

EE 5650 - Biomedical Optics

Light plays a significant role in modern clinical diagnostics and in the clinical treatment of disease. Examples include non-invasive surgery, optical biopsy, and cancer therapy. This course will focus on the study of how light propagates through biological tissue.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2016-2017 academic year

EE 5715 - Linear Systems Theory and Design

Overview of linear algebra, Modern Control: state-space based design of linear systems, observability, controllability, pole placement, observer design, stability theory of linear time-varying systems, Lyapunov stability, optimal control, Linear Quadratic regulator, Kalman filter, Introduction to robust control.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Electrical Engineering

Pre-Requisite(s): EE 3261 or MEEM 3750

EE 5726 - Wireless Sensor Networks

Introduces the concepts of wireless sensor networks. Topics include sensor network coverage and sensor deployment, time synchronization and sensor node localization, network protocols, data storage and very, collaborative signal processing. Introduce sensor network programming network reliability and tolerance.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand

Pre-Requisite(s): (CS 4461 or EE 4272 or EE 5722) and (EE 3170 or EE 3173) and (CS 1129 or CS 2141)

EE 5750 - Model-Based Embedded Control System Design

This course introduces embedded control system design using a model-based approach. Course topics include model-based embedded control system design, discrete-event control, sensors, actuators, electronic control unit, digital controller design, and communication protocols. Prior knowledge of hybrid electric vehicles is highly recommended.

Credits: 3.0

Lec-Rec-Lab: (0-2-2)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following College(s): College of Engineering; Must be enrolled in one of the following Major(s): Electrical Engineering

Pre-Requisite(s): (MEEM 4700 or MEEM 4775 or EE 3261 or EE 4261) and EE 4295

EE 5755 - Fault-Tolerant Systems

Covers both the theory and the practice of how to design, model, evaluate, and implement reliable systems out of unreliable components. Includes: Fault Models, Redundancy Management, Agreement, Consensus, Voting, Clock synchronization and reliable broadcast. Material is reinforced with real-world case studies.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand

Pre-Requisite(s): (MA 3710 or EE 3180) and (EE 4173 or CS 4431)

EE 5777 - Advanced Open-Source 3-D Printing

An introduction to distributed additive manufacturing using open-source 3-D printing. Design, use, and maintenance of open-source electronics and self-replicating rapid prototypers (RepRap). Graduate students will be expected to complete coursework and an in-depth project.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following College(s): College of Engineering

EE 5780 - Advanced VLSI Computer-Aided Design

Nanoscale chip design presents issues for IC designs and new market areas for design automation. This course provides a comprehensive introduction on layout design. Advanced algorithms and optimization techniques are presented to give students the skills needed for nanometer VLSI design.

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 4321 and EE 4271

EE 5805 - Directed Study in Electrical & Computer Engineering

Directed study on a topic mutually agreed upon by the student and the instructor. Credits: variable to 3.0; Repeatable to a Max of 6

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Electrical Engineering, Electrical Engineering

EE 5811 - Automotive Systems

Automotive systems for light duty vehicles are examined from the perspectives of requirements, design, technical, and economic analysis for advanced mobility needs. This course links the content for the automotive systems graduate certificate in controls, powertrain, vehicle dynamics, connected and autonomous vehicles.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Electrical Engineering, Automotive Systems & Controls, Computer Engineering

EE 5812 - Automotive Control Systems

Introduction to automotive control systems. Modeling and control methods are presented for: air-fuel ratio, transient fuel, spark timing, idle speed, transmission, cruise speed, anti-lock brakes, traction, active suspension systems, and hybrid electric vehicles. Advanced control methodologies are introduced for appropriate applications.

Credits: 3.0

Lec-ec-Lab: (0-3-0)

Semsters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Electrical Engineering, Computer Engineering

Pre-Requisite(s): EE 3261 or MEEM 4700 or MEEM 4775

EE 5821 - Computational Intelligence - Theory and application

This course covers the four main paradigms of Computational Intelligence, viz., fuzzy systems, artificial neural networks, evolutionary computing, and swarm intelligence, and their integration to develop hybrid systems. Applications of Computational Intelligence include classification, regression, clustering, controls, robotics, etc.

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 Level(s): Graduate

EE 5841 - Machine Learning

This course will explore the foundational techniques of machine learning. Topics are pulled from the areas of unsupervised and supervised learning. Specific methods covered include naive Bayes, decision trees, support vector machine (SVMs), ensemble, and clustering methods.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

Pre-Requisite(s): CS 4090

EE 5900 - Special Topics in Electrical Engineering

Special topics in electrical engineering selected by the student and approved by his/her advisor and the faculty member who will approve the study.

Credits: variable to 5.0; May be repeated

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Electrical Engineering, Computer Engineering

EE 5990 - Thesis Research in Electrical Engineering

Study of some acceptable electrical engineering problem and preparation of a thesis.

Credits: variable to 10.0; May be repeated; Graded Pass/Fail Only

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required

EE 5991 - Project Research in Electrical Engineering

Study of some acceptable electrical engineering problem and preparation of a report.

Credits: variable to 6.0; May be repeated; Graded Pass/Fail Only

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required

EE 5992 - Practical Experience in Electrical Engineering

A collaboration with industry on some acceptable electrical engineering task and preparation of a report.

Credits: variable to 4.0; May be repeated; Graded Pass/Fail Only

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of department required

EE 5994 - International Electrical and Computer Engineering Field Experience

Field work and reporting from students in the Peace Corps Master's International Program in Electrical and Computer Engineering.

Credits: 1.0; May be repeated

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Electrical Engineering, Computer Engineering

EE 6210 - Power System Dynamics and Stability

A study of the dynamic behavior of power systems. A review of synchronous machine modeling, system dynamic equations, and method of analysis.

Examines overall system behavior via small signal and transient stability and energy functions. Also studies voltage stability and non-linear effects.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): EE 5200

EE 6320 - Cyber Security of Automotive Systems II

This course covers advanced topics in cyber security of automotive systems. Topics include modeling and simulation of cyber attacks on vehicle subsystems, communications security for V2X systems, vulnerabilities in cooperative vehicle infrastructures, threat analysis, and cyber security of SAE level 2, 3, and 4 autonomous driving systems.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Computer Science, Mechanical Engineering, Mechanical Eng-Eng Mechanics, Computer Engineering, Electrical Engineering; Must be enrolled in one of the following Campus(s): Co-op and Online Course(s), Co-op Program, Off Campus, Off Campus MTU On-Line
Pre-Requisite(s): MEEM 5310 or EE 5310

EE 6702 - Nonlinear System Analysis and Control

Studies nonlinear systems from perspective of analysis/control system design. Explores fundamental properties for nonlinear differential equations in addition to describing functions, phase plane analysis, stability/instability theorems. Develops and applies control system design approaches for nonlinear systems, including feedback linearization and sliding mode control.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): EE 5715 or MEEM 5715

EE 6990 - Doctoral Research

Original research leading to the preparation of a dissertation in partial fulfillment of the requirements for the PhD degree.
Credits: variable to 15.0; May be repeated; Graded Pass/Fail Only
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required

Electrical Engineering Technology**EET 5000 - Independent Study in Electrical Engineering Technology**

Independent study in an approved topic under the guidance of an Electrical Engineering Technology staff member. Course of study may either be research or academic to be determined by student and faculty.
Credits: variable to 3.0; Repeatable to a Max of 6
Semesters Offered: On Demand
Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

EET 5100 - Test Engineering Fundamentals

Fundamental concepts of testing electrical or mechatronic devices are presented. Topics include design for testability, test economics and product quality, fault models, functional and statistical techniques, IC parametric tests, boundary scans, built-in self tests, and board level design for testability.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

EET 5120 - Electronic Manufacturing

Emphasizes fundamentals of signal transmission theory, digital circuit design, the role of packaging in circuit performance, and PCB manufacturing.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior
Pre-Requisite(s): EET 3281

EET 5142 - Digital Signal and Image Processing

Provides students with digital signal and image processing techniques with emphasis on applications. Covers concepts of sampling, digital filters and discrete Fourier transforms, image processing, enhancement, and restoration. The course requires proposing, executing, and defending at the graduate level, related to the course material project.
Credits: 4.0
Lec-Rec-Lab: (0-3-3)
Semesters Offered: Spring
Pre-Requisite(s): EET 3367 and (EET 4141 or EET 4311)

EET 5144 - 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
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): EET 1411 or EET 2220 or PH 2230 or EE 2110 or EE 3010

EET 5147 - Industrial Robotic Vision System and Advanced Teach Pendant Programming

Procedures for setting up, teaching, testing, and modifying robot vision systems widely used in industrial automation. Introduces advanced Teach Pendant Programming to develop complex scenarios for integrating robots into industrial cells. Final project must demonstrate proficiency in setting up and programming an advanced robotic vision scenario.
Credits: 4.0
Lec-Rec-Lab: (0-3-3)
Semesters Offered: Fall, Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): EET 4144 or EET 5144

EET 5171 - Quality Control

Fundamentals of statistical quality control are studied. Areas of study include process improvement, reduction of variation, root cause analysis, measures and costs of quality, systems thinking, and analysis and use of non-numeric test results such as modeling using ordinal variables.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Permission of instructor required; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

EET 5221 - EMC Test Engineering Fundamentals

Introduction to concepts and methodologies used in Electromagnetic Compatibility conformance testing. Course will explore common design flaws that result in EMC issues as well as industry standard test methods used to uncover those flaws. Intended as preparation for NARTE EMC Technician and Engineer exam.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior
Pre-Requisite(s): EET 5100

EET 5241 - Digital Hardware Testing

The course emphasizes fundamentals of digital hardware design for testability, faults in digital circuits, fault simulation and test generation, memory testing, testing of sequential circuits, microprocessor testing, digital circuit design, the role of packaging in circuit performance and PCB manufacturing.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior
Pre-Requisite(s): EET 5100

EET 5261 - Optical System Design and Testing

The fundamental concepts of optical system design and testing are presented at the moderate level. Simulation tools for modeling a broad range of optical components are designed to enhance the learning process. Laboratory experiments are intended to provide hands-on experience.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: On Demand
Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

EET 5311 - Advanced Circuits and Controls

Topics include: Fourier and Laplace transforms, signal comparison techniques and transfer functions. Control techniques addressed will include feedback, cascade, feedforward, multivariable and model based methods. Graduate students are expected to demonstrate ability in modeling/simulation techniques of linear systems.
Credits: 4.0
Lec-Rec-Lab: (0-3-3)
Semesters Offered: Fall
Pre-Requisite(s): EET 3131 or EET 4253

EET 5373 - Advanced Programmable Controllers

Using Allen Bradley Contr Logix and SLC500 programmable controllers, course covers structured programming, Sequential Function Charts, networking, proportional integral differential control, data acquisition and interfacing. The course requires proposing, executing, and defending at the graduate level related to the course material project.
Credits: 4.0
Lec-Rec-Lab: (0-2-3)
Semesters Offered: Spring
Pre-Requisite(s): EET 3373

EET 5990 - Special Topics in Electrical Engineering Technology

Electrical Engineering Technology topic of interest to faculty and student.
Credits: variable to 3.0; Repeatable to a Max of 12
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

Engineering Fundamentals

ENG 5100 - The Engineering Process

This course introduces the engineering problem solving and design processes. Students will learn about the engineering profession and will complete a design/build/test project.

Credits: 4.0

Lec-Rec-Lab: (0-3-2)

Semesters Offered: Summer

Restrictions: Must be enrolled in one of the following Level(s): Graduate

ENG 5200 - Engineering Applications in the Physical Sciences

This class will show how engineers use principles from the physical sciences to solve problems and design systems. Key concepts will be linked to the Michigan Curriculum Frameworks for precollege education.

Credits: 4.0

Lec-Rec-Lab: (0-3-2)

Semesters Offered: Summer

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): ENG 5100 or (ENG 5101 and ENG 5102)

ENG 5300 - Engineering Applications in the Earth Sciences

This course will show how engineers use principles from the earth sciences to solve problems and design systems. Key concepts will be linked to the Michigan Curriculum Frameworks for precollege education.

Credits: 4.0

Lec-Rec-Lab: (0-3-2)

Semesters Offered: Summer

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): ENG 5100

ENG 5400 - Engineering Applications in the Life Sciences

Students will gain hands-on experience linking engineering technologies to the biological sciences. Participants will visit labs and field sites at Michigan Tech to observe and participate in current research. Topics covered include biofuels, environmental restoration, environmental toxins, and ecosystem measurement.

Credits: 4.0

Lec-Rec-Lab: (0-3-2)

Semesters Offered: Summer

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): ENG 5100

ENG 5510 - Sustainable Futures I

Covers introductory and intermediate concepts of Sustainable Development. Explores methods/tools for assessing sustainability (economic, environmental, societal impacts) of current and emerging industrial technologies. Explores relationships between government policies and markets for introducing sustainable technologies into national economies and corporations.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

ENG 5520 - Sustainable Futures II

Covers sustainability in developed and developing countries. Topics include policy analysis, regulatory impact & cost benefit analyses, trade & markets, laws & regulations, international disasters, GIS applications, green manufacturing, and evolution of environmental policy in U.S. and other countries.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring

ENG 5540 - Sustainable Forest-Based Biofuel Pathways

This course provides an integrated multidisciplinary education in forest-based biofuel; forest biomass production, conversion by pyrolysis, catalytic upgrading, and vehicular combustion. Sustainability topics will include government biofuel policy, community impacts, techno-economics, and life cycle environmental impacts, with use of software.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2013-2014 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

ENG 5990 - 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

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

ENG 5998 - Engineering Design Practicum

An advanced independent study for students in the Master of Engineering program. In consultation with his/her advisor, the student develops and executes a project demonstrating capabilities in problem solving, communications, and decision making. The practicum can be completed on or off campus.

Credits: variable to 4.0; Repeatable to a Max of 4

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following College(s): College of Engineering

Enterprise

ENT 5950 - Graduate Enterprise Project Work

Interdisciplinary teams work as part of an enterprise to address real-world design projects or problems. Graduate students will actively participate in project work as defined by the team advisor, and provide technical expertise and mentorship to undergraduate team members.

Credits: variable to 3.0; Repeatable to a Max of 6

Semesters Offered: Fall, Spring

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

Forest Resources & Environmental Science

FW 5000 - Distinguished Ecologist Lecture Series

An opportunity to meet with some of the world's leading ecologists and to discuss their research. Pre- and post-lecture meetings enable students to review some of the research and discuss how it has impacted the field of ecology.

Credits: 1.0; May be repeated

Lec-Rec-Lab: (1-0-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate

FW 5020 - Woody Plants of North America

Identification and ecology of forest plants with an emphasis on tree and shrubs. Includes systematic study of the major forest vegetation types of North America.

Credits: 2.0

Lec-Rec-Lab: (1-0-3)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate

FW 5021 - Forest Certification

Reviews the history and application of the four major certification programs applicable to forests in the United States: Forest Stewardship Council (FSC); Sustainable Forestry Initiative (SFI); American Tree Farm System (ATFS); and Programme for the Endorsement of Forest Certification (PEFC). Prior knowledge of forest ecology is helpful.

Credits: 1.0

Lec-Rec-Lab: (1-0-0)

Semesters Offered: Summer

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

FW 5079 - Forest Management

Focus on forest resource management planning and decision making, emphasizing structured problem solving frameworks and decision support tools/models at forest and landscape scales.

Credits: 2.0

Lec-Rec-Lab: (1-0-1)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate

FW 5081 - Professionalism in Forestry

This class engages professional students in practicing soft skills for a forestry and/or natural resources management career. Emphasis will be on networking, communicating clearly to their intended audience, handling meetings, leadership, and public presentations. The professional society's code of ethics will be explored.

Credits: 1.0

Lec-Rec-Lab: (1-0-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Forestry

FW 5082 - Gene Expression Data Analysis

This course is designed for students majoring in molecular biology, computer science, data science and related majors to develop fundamental but essential skills for manipulating, preprocessing, and analyzing high throughput gene expression data for pattern extraction and knowledge discovery.

Credits: 3.0

Lec-Rec-Lab: (2-0-3)

Semesters Offered: Fall - Offered alternate years beginning with the 2018-2019 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): FW 4099 or CS 1121 or CS 1122 or CS 1131 or CS 1141 or CS 2321

FW 5083 - 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.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2017-2018 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

FW 5084 - Data Presentation and Visualization with R

This course is designed for graduate students majoring in forestry, wildlife, ecology, and natural resource management and data science to develop fundamental but essential skills for data presentation and visualization through generating informative graphs with R.

Credits: 2.0

Lec-Rec-Lab: (1-0-2)

Semesters Offered: Spring - Offered alternate years beginning with the 2017-2018 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

FW 5088 - Economic Analysis of Forestry

Financial analysis and economic theory applied to forestry project analysis and selection, focusing on prices. Covers risk, capital markets, taxation, auctions, land valuation, harvesting decisions, and non-market valuation.

Credits: 2.0

Lec-Rec-Lab: (2-0-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

FW 5092 - Experimental Design for Forestry and Natural Sciences

This lab is designed for graduate students majoring in forestry, wildlife, ecology, and natural resource management to develop fundamental but essential skills for designing experiments and analyzing data.

Credits: 3.0

Lec-Rec-Lab: (2-0-1)

Semesters Offered: Spring - Offered alternate years beginning with the 2019-2020 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

FW 5100 - Advanced Terrestrial Ecology

Structure and function of terrestrial ecosystems, focusing primarily on upland forests. Roles of climate, population structure, competition for above and belowground resources, natural disturbance, management, and global change on ecosystem community composition, succession, carbon exchange, productivity, and nutrient cycling.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2017-2018 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

FW 5115 - Restoration Ecology

Study the tools, challenges, and philosophical underpinnings associated with ecological restoration. Restoration of forest, grassland, and wetland communities (plant and animal) will be discussed.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2017-2018 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

FW 5130 - Forest Vegetation Dynamics

Investigation of how trees grow and interact in a variety of stand structures from a functional standpoint at both the tree- and stand-level. These principles will be used to test the use of silvicultural management tools for meeting a variety of objectives. Linkages will be made between stand development patterns and management options, with an emphasis on disturbance ecology.

Credits: 3.0

Lec-Rec-Lab: (2-1-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2017-2018 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore
Pre-Requisite(s): BL 3400 or FW 3010 or FW 3012 or FW 3020

FW 5133 - Intensive Silviculture

Applied forest ecology practices involving interventions to produce high levels of ecosystem services. Covers a full range of ecosystem goods and services, including carbon sequestration and biomaterials. Emphasizes quantitative metrics and methods for assessing and evaluating outcomes, including growth and yield.

Credits: 3.0

Lec-Rec-Lab: (1-2-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2017-2018 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

FW 5135 - Plant Community Ecology

Investigation of the theoretical underpinnings and quantitative tools associated with the study of plant communities.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2017-2018 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

FW 5180 - Ethics of Conservation and Sustainability

Discusses relationship between ecological science and environmental ethics as it relates to natural resource management, conservation and sustainability.

Credits: 2.0

Lec-Rec-Lab: (0-2-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate

FW 5201 - Forest Biometrics and Modeling

Overview and application of statistical techniques and sampling designs used in the forest environment for attribute monitoring and inventory. Use and evaluation of models that simulated forest development and their application in management and planning.

Credits: 2.0

Lec-Rec-Lab: (1-0-3)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Forestry

FW 5221 - Advanced Wetlands and Global Peatlands

This class concentrates on theoretical and technological advances understanding peatlands globally. Readings will pertain to major topics in wetland ecology, hydrology, soils, vegetation, biogeochemistry of arctic, boreal, temperate, mountain and tropical peatlands.

Credits: 2.0

Lec-Rec-Lab: (0-2-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2017-2018 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

FW 5330 - Applied Soil Science

A review of the chemical, physical, and biological properties of soil with emphasis on forest soils and emerging issues in forest management.

Credits: 3.0

Lec-Rec-Lab: (2-0-3)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate

FW 5340 - Population Genetics and Applied Forest Genetics

The course highlights populations genetic topics and deals with the effects of evolutionary factors on genetic diversity. The relevance of genetic variation patterns for the future management and conservation of forests is stressed. Quantitative methods in population genetics are presented.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2017-2018 academic year

FW 5368 - Forest Ecophysiology

Exploration of both classic and cutting-edge literature on the mechanistic aspects of tree and forest ecosystem function. Emphasis on the interactions between canopy structure, carbon flux, nutrient cycling, and water uptake in the context of global change.

Credits: 2.0

Lec-Rec-Lab: (0-2-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2016-2017 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

FW 5369 - Hydrology and Watershed Management

This survey course introduces the applications of hydrological concepts to evaluate the impacts of forest management and other land use activities/events on water yield, infiltration, evapotranspiration, stormflow, erosion, sedimentation, and water quality.

Credits: 1.0

Lec-Rec-Lab: (1-0-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

FW 5370 - Measuring Plants and the Environment

Hands-on exploration of instrumentation and data analysis techniques used in the study of forest ecophysiology and hydrology. Methods include: measurement of photosynthesis, respiration, sap flux, water potential, and micro-meteorological and hydrological variables.

Credits: 3.0

Lec-Rec-Lab: (0-2-3)

Semesters Offered: Fall - Offered alternate years beginning with the 2017-2018 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

FW 5371 - Snow Hydrology

This course will cover snow formation in the atmosphere, snow accumulation and distribution, snow metamorphism, avalanche dynamics, snowmelt and runoff, remote sensing of snow properties, and the impact of forests and under-snow biogeochemical processes.

Credits: 3.0

Lec-Rec-Lab: (2-1-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2018-2019 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

FW 5376 - Advanced Forest and Environmental Resource Management I

Application of forest and environmental management practices and topical investigations by teams of students with the assistance of faculty, staff and representatives of state, federal and corporate land management groups as well as non-governmental organizations.

Credits: 1.0; May be repeated

Lec-Rec-Lab: (0-1-0)

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Level(s): Graduate

FW 5377 - Advanced Forest & Environmental Resource Management II

Application of forest and environmental management practices and topical investigations by teams of students with the assistance of faculty, staff and representatives of state, federal and corporate land management groups as well as non-governmental organizations.

Credits: 2.0; May be repeated

Lec-Rec-Lab: (0-2-0)

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Level(s): Graduate

FW 5378 - Field Methods

To gain real world experience in measuring, monitoring, and assessing various projects involving active management and conservation of our university forest resources.

Credits: 1.0

Lec-Rec-Lab: (0-0-3)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Forestry

FW 5400 - Advanced 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

Restrictions: Must be enrolled in one of the following Level(s): Graduate

FW 5411 - Applied Regression Analysis

Regression as a tool for the analysis of forest and environmental science data. Topics include multiple linear, curvilinear and non-linear regression, hierarchical and grouped data and mixed-effects models. Emphasis is placed on application of tools to real-world data.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2018-2019 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

FW 5412 - Regression in R

Use of R for basic data manipulation, statistical summary and regression. Topics include installing R, data import and export, basic statistics, graphics and fitting of linear, non-linear and mixed-effects models.

Credits: 1.0

Lec-Rec-Lab: (0-1-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2018-2019 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Co-Requisite(s): FW 5411

FW 5421 - Climate Change and Management in Great Lakes Forested Systems

Provides an overview of climate change science, effects and adaptation for natural resource management in the Great Lakes region. Students develop climate change adaptation plans for real world forested ecosystem examples and learn how to communicate these climate change projects and plans with stakeholders.

Credits: 3.0

Lec-Rec-Lab: (2-1-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

FW 5510 - Special Topics in Natural Resources

Independent study of a specific area of natural resources.

Credits: variable to 9.0; Repeatable to a Max of 9

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Level(s): Graduate

FW 5517 - Soil Biogeochemistry

Study of the relationship between soil composition and the circulation of major elements through the earth system. Responses of biogeochemical cycles of the elements in agricultural, forest, grassland, and wetland soils to changes in land use, biodiversity, nutrient supply, plant stressors, and climate change will be discussed.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2017-2018 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

Pre-Requisite(s): CH 1150

FW 5519 - Atmospheric Biogeochemistry

Study of the relationship between atmospheric composition, global change, and the circulation of major elements through the Earth system. Responses of ecosystem emissions to changes in landuse, biodiversity, nutrient supply, plant stressors, and climate change are discussed.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring - Offered alternate years beginning with the 2016-2017 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

Pre-Requisite(s): CH 1150

FW 5540 - Remote Sensing of the Environment

Remote sensing principles and concepts. Topics include camera and digital sensor arrays, types of imagery, digital data structures, spectral reflectance curves, applications, and introductory digital image processing.

Credits: 3.0

Lec-Rec-Lab: (2-1-0)

Semesters Offered: Fall

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

Co-Requisite(s): FW 5541

FW 5541 - Remote Sensing of the Environment Lab

Applied introductory remote sensing analysis using industry standard software for digital image processing.

Credits: 1.0

Lec-Rec-Lab: (0-0-3)

Semesters Offered: Fall

Co-Requisite(s): FW 5540

FW 5550 - Geographic Information Science and Spatial Analysis

Use of geographic information systems (GIS) in resource management. Studies various components of GIS in detail, as well as costs and benefits. Laboratory exercises use ArcGIS software package to solve resource management problems.

Credits: 4.0

Lec-Rec-Lab: (3-0-3)

Semesters Offered: Fall

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

Pre-Requisite(s): MA 2710 or MA 2720 or MA 3710

FW 5553 - Python Programming for ArcMap GIS

An introduction to Python scripting and basic Python coding within ArcMap. Labs cover tasks found in typical GIS workflows. Students learn how to write and debug Python scripts, models and mapping programs.

Credits: 3.0

Lec-Rec-Lab: (2-0-3)

Semesters Offered: Fall

Pre-Requisite(s): FW 5550 or FW 3540

FW 5554 - GPS Field Techniques

This course will provide hands-on experience with various types of GPS units and different applications of the technology. These applications include planning, data collection, data processing, and data management. Emphasis will be on practical applications of Global Positioning System technology.

Credits: 2.0

Lec-Rec-Lab: (1-0-3)

Semesters Offered: Fall

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

FW 5555 - Advanced GIS Concepts and Analysis

This course moves beyond the fundamentals of GIS to explore the application of GIS technology to environmental monitoring and resource management issues. Students learn graphic modeling techniques, network analysis, 3D visualization, geodatabase construction and management, and multivariate spatial analysis.

Credits: 3.0

Lec-Rec-Lab: (2-0-3)

Semesters Offered: Spring

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

Pre-Requisite(s): FW 5550

FW 5556 - GIS Project Management

Course provides exposure to data collection techniques, web mapping applications, and advanced database structures. Students will investigate GIS system design, GIS project planning and data management, learn map atlas creation and cartographic techniques, and discuss geospatial ethics.

Credits: 3.0

Lec-Rec-Lab: (1-0-4)

Semesters Offered: Spring

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

Pre-Requisite(s): FW 5550

FW 5557 - Applied Spatial Statistics

Focus on spatial statistical methods such as spatial regression, geographically weighted regression and cluster analysis. ArcMap is utilized for analysis.

Credits: 3.0

Lec-Rec-Lab: (2-0-3)

Semesters Offered: Spring

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

Pre-Requisite(s): FW 5550

FW 5560 - Digital Image Processing: A Remote Sensing Perspective

Presents the theory and quantitative procedures of digital image processing using remotely sensed data. Emphasizes image acquisition, preprocessing, enhancement, transformation classification techniques, accuracy assessment, and out-products. Discusses linkages to GIS. Also covers evaluating applications of the technology to current resource management problems via peer-reviewed literature.

Credits: 4.0

Lec-Rec-Lab: (3-0-1)

Semesters Offered: Spring - Offered alternate years beginning with the 2019-2020 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

Pre-Requisite(s): FW 5540

FW 5580 - UAS(Drone)Remote Sensing and Photogrammetry

Applied fundamentals of aerial image interpretation, analysis and accurate measurements. Flight fundamentals, film and digital imagery, LIDAR, sensors, cameras, and lenses. Remotely Piloted Aircraft flight mission planning, image acquisition, aerotriangulation, point cloud and DEM/DSM generation. Preparation for FAA Remote Pilot Exam.

Credits: 4.0

Lec-Rec-Lab: (3-0-1)

Semesters Offered: Fall

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

Pre-Requisite(s): MA 1032 and (FW 5540 or FW 4540)

FW 5620 - Herpetology

The biology of amphibians and reptiles, including evolution, zoogeography, ecology, behavior and physiology.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2018-2019 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

FW 5678 - Natural Resources Field Service

This course provides a supervised field experience in natural resources and community development.

Credits: 1.0; May be repeated

Lec-Rec-Lab: (0-0-3)

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following College(s):

Sch of Forest Res & Envir Sci

FW 5700 - Graduate Field Forestry

For graduate students without an undergraduate degree in forestry or a closely related field. Covers field skills in mapping/GPS work, forest diseases and insects, wildlife, timber harvesting, natural resource inventory, and silviculture.

Credits: 8.0

Lec-Rec-Lab: (3-0-15)

Semesters Offered: Fall, Summer

FW 5701 - Graduate Field Applied Ecology

Field skills in mapping/GPS work, forest diseases and insects, wildlife, vegetation geomorphology, natural resource inventory and silviculture for graduate students without an undergraduate degree in environmental science or a closely related degree.

Credits: 8.0

Lec-Rec-Lab: (3-0-15)

Semesters Offered: Fall, Summer

FW 5730 - Field Work in International Forestry

Field work and reporting from students in the Peace Corps Loret Miller Ruppe Masters International Program in Forestry.

Credits: 1.0; May be repeated

Lec-Rec-Lab: (0-1-0)

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

FW 5780 - Agroforestry

Fundamental ecological processes and traditional use of woodlands, and socioecological issues including tenure, access, management, and policy. Farm systems analysis and the role of trees in farming systems. Also covers specific material on tropical soil conservation and crops.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

FW 5800 - Master's Graduate Seminar

Presentation by students of current natural resource- related problems and research. Some instruction on presentation skills.

Credits: 1.0

Lec-Rec-Lab: (0-1-0)

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

FW 5801 - Masters Seminar in GIS

Students will review, present, and discuss current research and applications of geospatial technology. This course is designed for students in the professional MS in GIS degree program, but will be open to students in other programs.

Credits: 1.0; Repeatable to a Max of 4

Lec-Rec-Lab: (1-0-0)

Semesters Offered: Fall, Spring

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

FW 5810 - Research Methods in Natural Resources

Overview of science and scientific research. The process of graduate education including choosing an advisor, selecting a research problem, writing a thesis proposal, scientific hypothesis testing, analyzing data, and communicating results through various media.

Credits: 2.0

Lec-Rec-Lab: (2-0-0)

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

FW 5811 - Advanced Responsible Conduct of Research in Natural Resources

Three four-hour workshops on advanced responsible conduct of research drawing on examples in natural resources. It covers the topics necessary for this training including ethical standards, publication practices, peer review process, conflict of interest and societal expectations.

Credits: 1.0

Lec-Rec-Lab: (0-1-0)

Semesters Offered: Summer

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

FW 5812 - Public Relations for Natural Resource Professionals

Explores current methods to effectively communicate natural resource concepts to the public. Students will develop a public relations plan for their organization and will gain skills in crafting a message, writing promotional materials, sourcing compelling imagery, managing digital media, organizing outreach events, and engaging stakeholders.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

FW 5999 - Forest Resources and Environmental Science Master's Research

An original investigation in forest science, ecology, and forest molecular genetics that culminates in a Master's degree.

Credits: variable to 15.0; May be repeated; Graded Pass/Fail Only

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Level(s): Graduate

FW 6800 - Doctoral Graduate Seminar

A seminar course in which current forest resource related problems and research are presented by students in the class. Some instruction on presentation skills.

Credits: 1.0; Repeatable to a Max of 2

Lec-Rec-Lab: (0-1-0)

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

FW 6980 - Graduate Teaching

Development of teaching skills through assisting in instruction. Students gain experience in course organization, lecture and laboratory instruction, and laboratory preparation.

Credits: variable to 4.0; Repeatable to a Max of 4

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

FW 6999 - Forest Resources and Environmental Science Doctoral Research

An original investigation in theoretical or experimental natural resources and submission of a dissertation in partial fulfillment of the requirements of the PhD degree.

Credits: variable to 15.0; May be repeated; Graded Pass/Fail Only

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Geological & Mining Engineering & Sciences**GE 5150 - Advanced Natural Hazards**

Exploration of how to develop comprehensive plans to mitigate the impact of natural hazards on humans. Requires a project and report.

Credits: 3.0

Lec-Rec-Lab: (2-0-3)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

GE 5180 - Volcanology

Volcanoes and how they work. Volcanic products, their recognition, and significance. Applies chemistry, physics, and fluid mechanics in a volcanological context.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

GE 5187 - Volcanological Field Seminar

Field Seminars of 1-3 weeks to volcanological sites of interest. These are offered in association and following GE5185. The field seminars are complemented by the preceding semester's classes, which examine the broad context of the field events. The two classes may be taken together as 4 credits or separately.

Credits: 2.0; May be repeated

Lec-Rec-Lab: (0-0-6)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Major(s): Geology, Geophysics, Geological Engineering; May not be enrolled in one of the following Class(es): Freshman, Sophomore

GE 5195 - Volcano Seismology

Will prepare students, including those with no seismology background, to interpret seismic and acoustic signals from volcanoes. Topics: basic seismology, monitoring techniques, tectonic and volcanic earthquakes, infrasound, deformation over a range of time scales.

Credits: 3.0

Lec-Rec-Lab: (2-0-1)

Semesters Offered: Spring

Pre-Requisite(s): (MA 1160 or MA 1161 or MA 1135) and GE 2000 and PH 2100

GE 5200 - Advanced Geochemistry

Introduction to advanced elements of modern geochemistry including aqueous solutions, isotopes, age dating, etc. Emphasizes concepts of quantitative methods. Teaches principles of thermodynamics and phase equilibria from an introductory perspective as they pertain to geologic systems Project and report required.

Credits: 3.0

Lec-Rec-Lab: (2-1-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

GE 5250 - Advanced Computational Geosciences

Introduction to quantitative analysis and display of geologic data using R/Matlab, covering basic R/Matlab syntax and programming, and analysis of one-dimensional (e.g. time series) and two-dimensional datasets (e.g. spatial data).

Techniques are applied to geological datasets. Requires an in-depth project, report, and presentation.

Credits: 3.0

Lec-Rec-Lab: (2-0-1)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

GE 5260 - Scientific Communication

Provide practice and advanced strategies in preparing, critiquing, and evaluating written communication. Will cover knowing your audience, scientific manuscript and proposal writing, reviewing, critiquing, and interpreting feedback. Students will prepare and critique written communication.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

GE 5400 - 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

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): MA 3160 and PH 2200 and GE 2000

GE 5430 - Advanced Planetary Geology and Geophysics

Geological, geophysical, and geochemical processes in the Solar System. Topics include the formation and evolution of the Solar System, planetary geological processes, impact structures, composition, structure, and dynamics of planetary interiors, geophysical exploration of planets. A term project/report is required.

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 5560 - Advanced Earthquake Seismology

Course covers fundamentals of the physics of earthquakes and seismic energy propagation, and seismic methods to determine Earth structure. Emphasis is placed on natural source techniques, with extension to exploration applications. Weekly labs apply techniques.

Credits: 3.0

Lec-Rec-Lab: (2-0-2)

Semesters Offered: Fall - Offered alternate years beginning with the 2015-2016 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): GE 3050 and PH 2100 and MA 3160

GE 5600 - Advanced Reflection Seismology

Principles and application of reflection seismic techniques. Includes acquisition, data processing, and 2D/3D data interpretation. Project and report required.

Credits: 3.0

Lec-Rec-Lab: (2-1-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

GE 5735 - Advanced Igneous Petrology

A quantitative examination of the thermodynamic and physical conditions of igneous rock formation using geochemistry, mineralogy, and rock textures.

Credits: 3.0

Lec-Rec-Lab: (2-0-3)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

GE 5785 - Seismic Petrophysics

Seismic petrophysics describes the use of rock physics information and logging data in the interpretation of reflection seismic data. The theories and empirical models relating seismic properties to other properties of rocks will be reviewed, and the logging techniques responsible for identifying those properties discussed. Various approaches to the quantitative interpretation of seismic data are covered. For varying course credit, projects with real data will be conducted by students.

Credits: variable to 3.0

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

GE 5800 - Mathematical Modeling of Earth Systems

Introduction to numerical techniques for mathematical modeling of various earth-system phenomena, including groundwater flow, heat transfer, and atmospheric transport. Numerical techniques covered include finite-difference, finite-element, collocation, and characteristic methods. Students write their own mathematical models. Prerequisite: experience in programming computer languages such as FORTRAN.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate

GE 5850 - Advanced Groundwater Engineering and Remediation

Computer modeling and other advanced topics in the analysis hydrological systems, contaminant transport and fate, and subsurface remediation systems.
Credits: 3.0

Lec-Rec-Lab: (0-2-3)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Class(es): Graduate

GE 5860 - Advanced Data Analysis and Inversion

The course covers a variety of topics in signal analysis and inversion. The signal analysis encompasses different methodologies and concepts to improve data quality and remove noise. Whereas data inversion is used to extract model parameters from the data. The course is useful for any discipline dealint with data analysis and inversion.

Credits: 3.0

Lec-Rec-Lab: (2-1-0)

Semesters Offered: Fall

GE 5870 - Geostatistics & Data Analysis

This course covers the handling of spatial and temporal data for knowledge discovery. Major topics include spatial interpolation, clustering, association analysis, and supervised and unsupervised classification. Students will learn how to use geostatistical and pattern recognition tools for geoscience applications.

Credits: 3.0

Lec-Rec-Lab: (2-0-1)

Semesters Offered: Fall, Spring

Pre-Requisite(s): GE 3250

GE 5930 - Special Topics in Geological Engineering

Study and discussion of geological engineering topics.

Credits: variable to 9.0; Repeatable to a Max of 9

Semesters Offered: On Demand

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

GE 5940 - Special Topics in Geology

Study and discussion of geology topics.

Credits: variable to 9.0; Repeatable to a Max of 9

Semesters Offered: On Demand

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

GE 5950 - Special Topics in Geophysics

Study and discussion of geophysics topics.

Credits: variable to 9.0; Repeatable to a Max of 9

Semesters Offered: On Demand

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

GE 5960 - Special Topics in Mining Engineering

Study and discussion of mining engineering topics.

Credits: variable to 9.0; Repeatable to a Max of 9

Semesters Offered: On Demand

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

GE 5970 - Special Topics in Global Environment Change

Course will focus on emerging topics on global environment change including changes in atmospheric composition and air quality, air pollution meteorology, extreme meteorological events, and ocean chemistry. Anthropogenic contributions to these changes will be presented and analyzed. Students will work on course projects based on historical records from multiple datasets to evaluate and appreciate the long-term changes in the global environment and better understand the perturbations due to human activities.

Credits: 3.0; Repeatable to a Max of 6

Lec-Rec-Lab: (2-1-0)

Semesters Offered: Fall, Spring

GE 5994 - International Geological Practicum

Geological field work outside of the U.S. used by Peace Corps Master International students during their field assignments. May be used repeatedly up to 12 credits.

Credits: 1.0; Repeatable to a Max of 12

Lec-Rec-Lab: (0-1-0)

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Major(s): Geology, Geophysics, Geological Engineering

GE 5995 - Domestic Geological Practicum

Project course for students serving in a U.S. based service activity for one or more semesters. The service activities pertain to community development in the context of geological resource development, restoration, or protection or geological hazard mitigation.

Credits: 1.0; May be repeated

Lec-Rec-Lab: (0-0-3)

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

GE 5998 - International Geology Master's Research

An original investigation in theoretical or experimental natural geological hazard mitigation and submission of a thesis or report in partial fulfillment of the MS degree conducted while in the Peace Corps Program.

Credits: variable to 9.0; Graded Pass/Fail Only

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following College(s): College of Engineering

GE 5999 - Master's Graduate Research

Research of an acceptable geological engineering, mining engineering, geology, or geophysics problem and preparation of a thesis.

Credits: variable to 15.0; May be repeated; Graded Pass/Fail Only

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Level(s): Graduate

GE 6999 - Doctoral Graduate Research

Original research of an acceptable geological engineering, mining engineering, geology, or geophysics problem and preparation of a PhD dissertation.

Credits: variable to 15.0; May be repeated; Graded Pass/Fail Only

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Humanities**HU 5000 - Introduction to Graduate Studies in Rhetoric, Theory, and Culture**

Prepares students for graduate level work in the RTC program and introduces them to the fields of scholarly inquiry covered by graduate faculty.

Credits: 1.0; Graded Pass/Fail Only

Lec-Rec-Lab: (0-1-0)

Semesters Offered: Fall

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Rhetoric, Theory and Culture

HU 5002 - Rhetoric and Composition

This course considers key theoretical, pedagogical, and historical issues and events that have linked the fields of rhetoric, composition, and literacy studies.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Rhetoric, Theory and Culture, Rhetoric & Tech Communication

HU 5003 - Technical and Scientific Communication

This course considers key historical, pedagogical, and theoretical issues in technical and scientific communication, and technology studies. Considerable attention is paid to the practice and critique of technical communication and technology in academic and non-academic settings.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Rhetoric, Theory and Culture, Rhetoric & Tech Communication

HU 5004 - Cultural Theory

Study of major cultural theories such as structuralism, poststructuralism, Marxism, feminist theory, postmodernism, cultural studies, postcolonial studies, and discourse theory.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Rhetoric, Theory and Culture, Rhetoric & Tech Communication

HU 5006 - Continental Philosophy

Study of major figures and themes in continental philosophy. Topics might include: human being, temporality, historicity, tradition, language, perception, embodiment, intersubjectivity, politics, and technology. Approaches to these issues may include phenomenology, hermeneutics, deconstruction, feminist theory, and critical theory.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

HU 5007 - Critical Perspectives on Globalization

Advanced study of genres, stages, and manifestations of globalization, with an emphasis on critical discourses that seek to understand this phenomenon from humanistic and cultural perspectives.

Credits: 3.0; Repeatable to a Max of 6

Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

HU 5008 - Critical Approaches to Literature and Culture

Advanced study of genres, periods and movements in literature and culture. May include transnational movements, comparative studies, oral literature, electronic literature, literary and critical theory and other disciplines and/or arts.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

HU 5010 - Organizational Communication

Theoretical review of the role of communication in organizations. Emphasizes critical interpretive approaches.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

HU 5011 - Technology, Culture and Communication

Examines philosophical and theoretical concepts for understanding the cultural role of technology such as causality, determinism, progress, identity, agency, articulation, assemblage, social space, control, and change.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

HU 5012 - Communication Theory

Traces the development of communication theories. Emphasizes interactions among theoretical, political, historical, and socio-cultural factors.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

HU 5020 - Composition Theory

An introduction to such issues in composition theory as the relationships of thought to language, of spoken to written language, of reading to writing, of writing to learning, and of process to product.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

HU 5021 - Literacy Theory and Research

A study of the social, cultural, and ideological implications of literacy practices using a variety of historical, theoretical, and ethnographic accounts.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

HU 5030 - Linguistic Analysis

The study of linguistic theories and methods for analyzing oral, written, and/or electronic texts. Topics may include how societies construct and are constructed through language; gender, ethnicity, power, class, and region in sociolinguistic variation; theories of discourse; pragmatics; semantics; and methods, ethics, and coding in data collection and analysis.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

HU 5050 - Theories of Interculturality

A comparative, critical examination of cross-language and cross-cultural equivalencies and differences through the study of acculturation, values, traditions, role expectations, perceptions, stereotypes, and gender issues.

Credits: 3.0; Repeatable to a Max of 9

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

HU 5070 - History and Theory of Rhetoric

History and theory of rhetoric, focusing on ancient rhetoric, alternative rhetorics, and/or modern rhetorical theory.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

HU 5090 - Writing Creative Nonfiction

Writing and revising creative nonfiction in a workshop format. Course may include introduction to contemporary and historical works in the field, as well as study of its theories, techniques, and sub-genres.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

HU 5091 - Writing for Publication

Practice in writing to the requirements of professional publications and in identifying the rhetorical considerations of writing for different publications.

Credits: variable to 3.0; Repeatable to a Max of 6

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

HU 5100 - Qualitative Humanistic Research

Examination of qualitative methodology and compatible methods, with attention to modes of data collection and analysis, and ethical research practices, such as confidentiality and informed consent. Approaches may include ethnographic; phenomenological; narratological; rhetorical; historical; grounded theory; or standpoint theory.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

HU 5110 - Backgrounds of Critical Theory

Study of major critical theories that have influenced contemporary theories such as feminist theory, postmodern theory, cultural studies, critical pedagogy, and discourse theory. Focuses on primary texts in Marxist theory, structuralism, poststructuralism, and phenomenology, and introduces students to the challenges of reading theoretical texts and texts in translation.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

HU 5112 - Theoretical Perspectives on Technology

Philosophical, rhetorical, literary, and/or cultural studies perspectives on technology.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

HU 5113 - Cultural Studies

Introduction to the theoretical history, methods, and practice of cultural studies. Includes the influence of literary humanism, Marxism, structuralism, subcultural studies, feminism, postmodernism, articulation theory, Deleuze and Guattari.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

HU 5114 - Visual Theory and Analysis

A critical survey of selected theoretical, analytic and methodological issues that inform various disciplinary perspectives on visibility, visual culture, images, and image-based media, and visual representation.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

HU 5116 - Approaches to Alterity and Difference

A critical examination of discourses, theories, and representations of otherness or difference according to race, gender, sexuality, class, age, nationality, ethnic background, and other socio-cultural categories. May include discussion of issues of self-representation within and among groups, the rhetorics of exile or diaspora, colonial and postcolonial constructions of identity.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

HU 5117 - Theories of Language

Study of major theories of language that have influenced contemporary work on discourse, language, and literacy. Focuses on language theorists from one or more of a variety of disciplines, such as philosophy, linguistics, literary studies, psychology, anthropology, and rhetoric.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

HU 5119 - Fieldwork in International English Education

Fieldwork and reporting from students in the Peace Corps Master's International Program in Rhetoric and Technical Communication.

Credits: 1.0; May be repeated

Lec-Rec-Lab: (0-1-0)

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

HU 5711 - Biomedical Research Ethics

Examination of bioethical issues in biomedical research. Topics include research on human subjects, on vulnerable populations, and animals, principles of ethical research, and societal expectations for researchers. This course qualifies for credit in Advanced RCR Training.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2018-2019 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

HU 5870 - New Media Theory

Examines development of theories explaining the cultural significance of new media technology in communication. Emphasizes strengths and weaknesses of these theories, the concept of "new", and emergent theories challenging the centrality of media in the digital and biotechnological age.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

HU 5900 - Independent Study

Guided research under the direction of a member of the graduate faculty. Open to advanced master's students in RTC only. Students must meet with their supervising instructor and receive approval of their study plan from the Director of RTC before registering.

Credits: variable to 6.0; Repeatable to a Max of 6

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Rhetoric, Theory and Culture, Rhetoric & Tech Communication

HU 5901 - Directed Reading

Directed reading in a focused area under the direction of a member of the graduate faculty, open to advanced MS students in RTC. Students must file a plan of study and receive approval from the supervising faculty and the Director of RTC before registering.

Credits: variable to 6.0; Repeatable to a Max of 6

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Rhetoric, Theory and Culture, Rhetoric & Tech Communication

HU 5902 - Internship

Work experience under the direction of a member of the graduate faculty, for advanced MS students. May be conducted on or off campus. Work off campus requires additional direction by an off-campus supervisor. Students must receive approval from their supervising instructor and the Director of RTC before registering.

Credits: variable to 6.0; Repeatable to a Max of 6

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Rhetoric, Theory and Culture, Rhetoric & Tech Communication

HU 5931 - Composition Pedagogy

A study of pedagogical techniques, technologies, evaluation, and assessment. Topics may include practical strategies and theories of rhetorical analysis, reflective speaking practices, critical visual design, and composition. GTAs in the RTC program in their first year of teaching are required to enroll in two consecutive semesters of this course.

Credits: variable to 3.0

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

HU 5932 - Practicum in Teaching Technical Communication

Principles of technical and scientific communication pedagogies and practices. Offers guidance in assignment design, institutional assessment, and policy development through discussion, classroom observation, and reading. One semester required for GTIs new to teaching HU3120.

Credits: 1.0

Lec-Rec-Lab: (0-1-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): HU 5931

HU 5933 - Practicum in Modern Language Pedagogy

Discussion and development of effective pedagogical practices and reading of research, scholarship, and theory of modern language pedagogy. GTAs will observe modern language classes regularly and reflect on their own and others' practices. Required of all GTAs in the RTC program in their first year of language teaching at MTU.

Credits: 1.0

Lec-Rec-Lab: (0-1-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

HU 5934 - Practicum in Communication Pedagogy

Principles of the practice and pedagogy of teaching communications. Offers guidance in class and assignment design, class policy, options for readings, and strategies for teaching. One semester required for graduate students new to teaching communications.

Credits: 1.0

Lec-Rec-Lab: (0-1-0)

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): HU 5931

HU 5935 - Practicum in Writing Center Administration

Study of theory and practice of writing center administration. Topics may include pedagogical and tutoring techniques, writing center assessment, and research methods.

Credits: 1.0

Lec-Rec-Lab: (0-1-0)

Semesters Offered: On Demand

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Rhetoric, Theory and Culture
Pre-Requisite(s): HU 5931

HU 5936 - Practicum in Media Pedagogy

Principles of media studies pedagogies and practices. Offers guidance in class and assignment design, class policy, options for readings and strategies for teaching. Required for students new to teaching media.

Credits: 1.0

Lec-Rec-Lab: (0-1-0)

Semesters Offered: On Demand

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Rhetoric, Theory and Culture
Pre-Requisite(s): HU 5931

HU 5990 - Thesis

Individual research or scholarship under the direction of a graduate faculty advisor. Open to students in the master's program in rhetoric and technical communication. Students must meet with their advisors before registering.

Credits: variable to 10.0; May be repeated; Graded Pass/Fail Only

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Rhetoric, Theory and Culture, Rhetoric & Tech Communication

HU 5991 - Special Projects

Individual projects under the direction of a graduate advisor. Open to master's students in RTC only. Students must meet with their advisors before registering.

Credits: variable to 6.0; May be repeated; Graded Pass/Fail Only

Semesters Offered: On Demand

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Rhetoric, Theory and Culture, Rhetoric & Tech Communication

HU 5992 - Independent Study: Coursework Paper

Students prepare a coursework paper in preparation for the oral coursework defense.

Credits: variable to 3.0; Repeatable to a Max of 3

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Rhetoric, Theory and Culture, Rhetoric & Tech Communication

HU 6000 - Special Topics in Literacy Studies

Advanced study of special topics in literacy studies including theories of pedagogy and relationships among literacy, technology, society, and education.

Credits: 3.0; Repeatable to a Max of 9

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

HU 6010 - Special Topics in Communication

In-depth examination of topics in communication.

Credits: 3.0; Repeatable to a Max of 9

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

HU 6020 - Special Topics in Composition

In-depth examination of theoretical perspectives on composing. May include discussion of current-traditional, expressivist, social constructionist, and postmodern perspectives.

Credits: 3.0; Repeatable to a Max of 9

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

HU 6050 - Special Topics in Language and Literature

Advanced study of topics in languages and literature including U.S., British, and world. May include intercultural and comparative studies and the reading of literature, literary and critical theory, translation, and film.

Credits: 3.0; Repeatable to a Max of 9

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

HU 6060 - Special Topics in Philosophy

Advanced study of selected topics in philosophy. Possible topics include philosophy of literature, philosophy of mind, continental philosophy, analytic philosophy, theories of truth, philosophical issues in cognitive science, contemporary feminist philosophy, and issues in social, political, and legal philosophy.

Credits: 3.0; Repeatable to a Max of 9

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

HU 6070 - Special Topics in Rhetoric and Composition

Advanced study of special topics in rhetorical or composition theory, history, or practice.

Credits: 3.0; Repeatable to a Max of 9

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

HU 6090 - Special Topics in Pedagogy

Special topics in pedagogy. Offers guidance in course design and teaching strategies for a specific undergraduated course in Humanities.

Credits: 1.0; Repeatable to a Max of 3

Lec-Rec-Lab: (0-1-0)

Semesters Offered: On Demand

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): HU 5931

HU 6110 - Special Topics in Critical Inquiry

Advanced study of contemporary theoretical perspectives in rhetoric and technical communication. Topics might include cultural studies, theories of representation, feminist theory, Marxist theory, postmodern theory, critical perspectives on the environment.

Credits: 3.0; Repeatable to a Max of 9

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

HU 6111 - Special Topics in Gender Studies

An inquiry into the ways in which gender is constituted within and affects rhetorical, representational, and communicative processes, situations, and structures.

Credits: 3.0; Repeatable to a Max of 9

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

HU 6112 - Special Topics in New Media

A study of the design and evaluation of interactive texts on the computer, with emphasis on critical and theoretical issues raised by the visuality, shifting word-image ratio, and interactivity possible on computer screens.

Credits: 3.0; Repeatable to a Max of 9

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

HU 6114 - Special Topics in Visual Representation

A critical examination of selected topics in visual representation, with an emphasis on the theoretical, industrial, cultural, international and national, and aesthetic contexts that inform an understanding of particular visual media. May include such topics as genre studies, reception theory and theories of spectatorship, gender and visual representation, etc.

Credits: 3.0; Repeatable to a Max of 9

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

HU 6115 - Special Topics in Technical Communication

Advanced study of special topics in Technical Communication (TC). May include theories of TC; feminist studies of TC; study of TC in international contexts; theories and practices of usability; TC research methods and methodologies.

Credits: 3.0; Repeatable to a Max of 9

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

HU 6900 - Independent Study

Guided research under the direction of a member of the graduate faculty. Open to advanced doctoral students in RTC only. Students must meet with their supervising instructor and receive approval of their study plan from the Director of RTC before registering.

Credits: variable to 6.0; Repeatable to a Max of 6

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Rhetoric, Theory and Culture, Rhetoric & Tech Communication

HU 6901 - Directed Reading

Directed reading in a focused area under the direction of a member of the graduate faculty, for advanced PhD students in RTC. Credit varies according to the nature of the reading. Students must file a plan of study and receive approval from the supervising faculty and the Director of RTC before registering.

Credits: variable to 6.0; Repeatable to a Max of 9

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Rhetoric, Theory and Culture, Rhetoric & Tech Communication

HU 6902 - Internship

Work experience under the direction of a member of the graduate faculty, for advanced PhD students. May be conducted on or off campus. Work off campus requires additional direction by an off-campus supervisor. Students must receive approval from their supervising instructor and the Director of RTC before registering.

Credits: variable to 6.0; Repeatable to a Max of 6

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Rhetoric, Theory and Culture, Rhetoric & Tech Communication

HU 6903 - Doctoral Qualifying Exam

Students prepare for comprehensive examination.

Credits: variable to 9.0; May be repeated; Graded Pass/Fail Only

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Rhetoric, Theory and Culture, Rhetoric & Tech Communication

HU 6990 - Doctoral Research

By arrangement with the instructor directing the PhD dissertation

Credits: variable to 10.0; May be repeated; Graded Pass/Fail Only

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Rhetoric, Theory and Culture, Rhetoric & Tech Communication

Kinesiology & Integrative Physiology**KIP 5000 - Advanced Exercise Physiology**

This course focuses on exercise physiology in both humans and rodents. Topics include detailed muscle physiology, fatigue mechanisms, the autonomic nervous system, advanced cardiovascular adaptations with exercise, exercise metabolism, and environmental exercise physiology. The importance of translational research will be highlighted.

Credits: 3.0

Lec-Rec-Lab: (2-1-0)

Semesters Offered: Fall

Pre-Requisite(s): (EH 4210 or KIP 4100) and (EH 4211 or KIP 4110)

KIP 5100 - Advanced Biomechanics

This course includes the quantitative analysis of human motion through bioinstrumentation during dynamic performance. A detailed analysis of different movements and movement techniques, as well as investigations into the mechanics of tissues and their function, are included in this course.

Credits: 3.0

Lec-Rec-Lab: (2-1-0)

Semesters Offered: Spring

Pre-Requisite(s): (EH 4500 or KIP 4200) and (EH 4511 or KIP 4210)

KIP 5200 - Advanced Strength and Conditioning

Advanced 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: (2-1-0)

Semesters Offered: Spring

Pre-Requisite(s): EH 5310 or KIP 5000 or EH 5320 or KIP 5100 or EH 5330 or KIP 5300

KIP 5300 - Advanced Motor Learning and Control

This course will provide the current theories and concepts involved in the processes of motor skill acquisition and performance from a behavioral perspective. Additional peer-reviewed literature will be utilized toward an oral presentation.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall, Spring

Restrictions: Permission of department required

KIP 5450 - Aging, Cognition, and Motor Behavior

Seminar on current research on age-related changes in cognitive function, motor behavior, and the interaction between cognitive decline and motor performance.

Topics include the impact of aging on memory, attention, cognitive control, gait, balance, and motor learning.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

KIP 5500 - Systems Physiology

A comprehensive systemic study of the physiological functions of the adult human, including an introduction to the underlying etiologies and clinical indicators of molecular, cellular, and tissue bases for common organ system diseases in humans.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate

KIP 5510 - Molecular Physiology

Introduction on how different biochemical and molecular pathways of the cell work together to produce various physiological functions. Emphasis will be placed on the molecular and cellular mechanisms underlying physiological processes. Structure and function relationship will be addressed throughout the course.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2018-2019 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

KIP 5700 - Graduate Seminar

Graduate seminars are designed to facilitate critical discussions of student research projects and peer-reviewed research in related fields. The presenter will provide an overview or seminar of the research of interest, which will establish the foundation for the discussion thereafter.

Credits: 1.0; Repeatable to a Max of 2

Lec-Rec-Lab: (0-1-0)

Semesters Offered: Fall, Spring

Restrictions: Permission of department required

Pre-Requisite(s): EH 5310 or KIP 5000 or EH 5320 or KIP 5100 or EH 5330 or KIP 5300

KIP 5711 - Biomedical Research Ethics

Examination of bioethical issues in biomedical research. Topics include research on human subjects, on vulnerable populations, and animals, principles of ethical research, and societal expectations for researchers. This course qualifies for credit in Advanced RCR training.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2018-2019 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

KIP 5800 - Special Topics in Kinesiology

Selected additional topics in kinesiology for advanced students based on interests of faculty and students. Interested students should contact the Exercise Science, Health and Physical Education department.

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 Level(s): Graduate

KIP 5900 - Graduate Internship in Kinesiology

Practical experience in the field of kinesiology at an approved internship site. Internships must be approved by department chair or graduate director, and work a minimum of 42 hours for each credit earned.

Credits: variable to 6.0

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of department required

KIP 5999 - Master's Thesis in Research

An original research investigation in kinesiology that culminates in a thesis.

Credits: variable to 9.0; Repeatable to a Max of 20; Graded Pass/Fail Only

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

KIP 6100 - Doctoral Graduate Seminar in Integrative Physiology

The graduate seminar is designed to facilitate critical discussions of peer-reviewed research and student research projects in the field of integrative physiology. The presenter will provide an overview or seminar of the research of interest, which will establish the foundation for the discussion thereafter.

Credits: 1.0

Lec-Rec-Lab: (0-1-0)

Semesters Offered: Fall, Spring

Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Integrative Physiology

KIP 6800 - Special Topics in Integrative Physiology

Examination of current topics in the field of integrative physiology. Literature and research topics are addressed.

Credits: variable to 9.0; Repeatable to a Max of 9

Semesters Offered: Fall, Spring

Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Integrative Physiology, Kinesiology

KIP 6999 - Doctoral Research

An original investigation in theoretical or experimental physiology, or both, and submission of a dissertation.

Credits: variable to 9.0; May be repeated; Graded Pass/Fail Only

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Integrative Physiology

Mathematical Sciences**MA 5201 - Combinatorial Algorithms**

Basic algorithmic and computational methods used in the solution of fundamental combinatorial problems. Topics may include but are not limited to backtracking, hill-climbing, combinatorial optimization, linear and integer programming, and network analysis.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2010-2011 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

MA 5221 - Graph Theory

Review of basic graph theory followed by one or more advanced topics which may include topological graph theory, algebraic graph theory, graph decomposition or graph coloring.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2003-2004 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): MA 5301 or MA 4209

MA 5222 - Design Theory

Methods for the construction of different combinatorial structures such as difference sets, symmetric designs, projective geometries, orthogonal latin squares, transversal designs, steiner systems and tournaments.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Pre-Requisite(s): MA 4209 and MA 5301

MA 5231 - Error-Correcting Codes

Basic concepts, motivation from information transmission, finite fields, bounds, optimal codes, projective spaces, duality and orthogonal arrays, important families of codes, MacWilliams' identities, applications.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

MA 5280 - Topics in Applied Combinatorics

Topics will vary with instructor but will emphasize real world applications of combinatorial methods. Topics include: cryptography, network reliability, operations research or scheduling, among many other possible choices.

Credits: 3.0; Repeatable to a Max of 48

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2010-2011 academic year

Restrictions: Permission of department required

MA 5301 - Algebra I

Theory of finite groups, their actions and applications. Review of basic group theory (Sylow theorems). Simple groups and group actions (transitivity). Symmetric and alternating groups, linear groups and more general classical groups. Applications: finite fields, designs, finite geometries.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): MA 4310

MA 5302 - Algebra II

Introduction to polynomial rings, finite fields and field extensions. Review of basic notions concerning rings, polynomials and power series. General theory of finite and algebraic field extensions. The basics of Galois theory (field extensions and their Galois groups).

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Pre-Requisite(s): MA 5301

MA 5320 - Commutative Algebra

Introduction to commutative algebra and combinatorial algebra. A first description of research issues is also given. Topics include: commutative rings (quotients, morphisms; prime, maximal ideals); modules, Noetherian, artinian rings; combinatorial algebra (gradings, monomials, Hilbert functions, resolutions, level, Gorenstein algebras).

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2010-2011 academic year

Restrictions: Permission of instructor required

Pre-Requisite(s): MA 4310

MA 5360 - Number Theory

Topics may include, but not limited to, unique factorization, elementary estimates on the distribution of prime numbers, congruences, Chinese remainder theorem, primitive roots, n -th powers modulo an integer, quadratic residues, quadratic reciprocity, quadratic characters, Gauss sums, and finite fields.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2011-2012 academic year

Restrictions: Permission of instructor required

Pre-Requisite(s): MA 4310

MA 5390 - Scientific Computing

Set in a Linux environment, course offers exposure to Foss tools for developing computational and visualization workflows. Students will learn to translate problems into programs, understand sources of errors, and debug, improve the performance of and parallelize the code.

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

MA 5401 - Real Analysis

A graduate-level study of the Lebesgue integral including its comparison with the Riemann integral; the Lebesgue measure, measurable functions and measurable sets. Integrable functions, the monotone convergence theorem, the dominated convergence theorem, and Fatou's lemma.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

MA 5501 - Theoretical Numerical Analysis

Functional analytic basis of modern numerical analysis. Linear spaces, including Sobolev space theory, linear operators, approximation theory, and applications to Fourier analysis, fixed point theorems, iterative methods, finite difference methods, etc.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Pre-Requisite(s): MA 4330 and MA 4450

MA 5510 - Ordinary Differential Equations I

Qualitative theory of solutions of ordinary differential equations, including existence, uniqueness, and continuous dependence; theory of linear equations; solution of constant coefficient systems; phase plane analysis; design and analysis of numerical methods.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Pre-Requisite(s): MA 4450 and MA 4330

MA 5565 - Partial Differential Equations

Theory of partial differential equations. Covers classification, appropriate boundary conditions and initial conditions, PDEs of mathematical physics, characteristics, Green's functions, and variational principles.

Credits: 3.0

Lec-ec-Lab: (0-3-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): MA 5501

MA 5580 - Topics in Applied Mathematics

Topics will vary with instructor, but will cover areas in applied mathematics.

Credits: 3.0; Repeatable to a Max of 48

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

MA 5627 - Numerical Linear Algebra

Design and analysis of algorithms for the numerical solution of systems of linear algebraic equations, least-square problems, and eigenvalue problems. Direct and iterative methods will be covered.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Pre-Requisite(s): MA 4330 or MA 4630

MA 5629 - Numerical Partial Differential Equations

Analysis and design of algorithms for the numerical solution of partial differential equations.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Pre-Requisite(s): MA 4610 or MA 5627 and MA 5501

MA 5630 - Numerical Optimization

Numerical solution of unconstrained and constrained optimization problems and nonlinear equations. Topics include optimality conditions, local convergence of Newton and Quasi-Newton methods, line search and trust region globalization techniques, quadratic penalty and augmented Lagrangian methods for equality-constrained problems, logarithmic barrier method for inequality-constrained problems, and Sequential Quadratic Programming.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2002-2003 academic year

Pre-Requisite(s): MA 4330 or MA 4610 or MA 4630 or MA 5627

MA 5701 - Statistical Methods

Introduction to design, conduct, and analysis of statistical studies, with an introduction to statistical computing and preparation of statistical reports. Topics include design, descriptive, and graphical methods, probability models, parameter estimation and hypothesis testing.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

MA 5711 - Mathematical Statistics I

Review of distribution theory and transformation theory of random variables.

Topics include sufficiency; exponential and Bayesian models; estimation methods, including optimality theory; basics of confidence procedures and hypothesis testing, including the Neyman-Pearson framework.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Pre-Requisite(s): MA 4450 and MA 4760 and MA 4770

MA 5712 - Mathematical Statistics II

Optimal tests and decision theory. Other topics may include regression and analysis of variance, discrete data analysis, nonparametric models.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Pre-Requisite(s): MA 5711

MA 5730 - Nonparametric Statistics

Introduces nonparametric techniques that require less restrictive assumptions on the data. Topics include statistical inference concerning location and dispersion parameters as well as the general distributions. Goodness-of-fit tests for count and ordinal data are also discussed.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2019-2020 academic year

Pre-Requisite(s): MA 2710 or MA 2720 or MA 3710 or MA 3715

MA 5731 - Linear Models

A unified development of linear statistical models that includes the following topics: matrices and quadratic forms, normal and chi-square distribution theory, ordinary and generalized least squares modeling, estimability, estimation and tests of hypothesis.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Pre-Requisite(s): MA 4710 and MA 4720 and MA 4760 and MA 4330

MA 5732 - Generalized Linear Models

The focus of this course is on generalized linear models (GLM), including the structure of GLM, statistical theory for GLM (maximum-likelihood estimation of GLM and hypothesis tests), and their applications. Also covers generalized linear mixed and random effects models.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2017-2018 academic year

Pre-Requisite(s): (MA 4710 or MA 5731) and (MA 4770 or MA 5712)

MA 5741 - Multivariate Statistical Methods

Random vectors and matrix algebra. Multivariate Normal distribution. Theory and application of multivariate techniques including discrimination and classification, clustering, principal components, canonical correlation, and factor analysis.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Pre-Requisite(s): (MA 4710 or MA 4720) and MA 2320

MA 5750 - Statistical Genetics

Application of statistical methods to solve problems in genetics such as locating genes. Topics include basic concepts of genetics, linkage analysis and association studies of family data, association tests based on population samples (for both qualitative and quantitative traits), gene mapping methods based on family data and population samples.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2015-2016 academic year

MA 5761 - Computational Statistics

Introduction to computationally intensive statistical methods. Topics include resampling methods, Monte Carlo simulation methods, smoothing technique to estimate functions, and methods to explore data structure. This course will use the statistical software S-plus.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Pre-Requisite(s): MA 4770(C)

MA 5770 - Bayesian Statistics

The theory of Bayesian inference. Topics include prior specifications, basics of decision theory, Markov chain, Monte Carlo, Bayes factor, linear regression, linear random effects model, hierarchical models, Bayesian hypothesis testing, Bayesian model selection.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2016-2017 academic year

Pre-Requisite(s): MA 4330 and MA 4710 and MA 4760

MA 5781 - Time Series Analysis and Forecasting

Statistical modeling and inference for analyzing experimental data that have been observed at different points in time. Topics include models for stationary and non stationary time series, model specification, parametric estimation, model diagnostics and forecasting, seasonal models and time series regression models.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Pre-Requisite(s): (MA 2710 or MA 2720 or MA 3710 or MA 3715) and (MA 3720 or EE 3180)

MA 5790 - Predictive Modeling

Application, construction, and evaluation of statistical models used for prediction and classification. Topics include data pre-processing, over-fitting and model tuning, linear and nonlinear regression models and linear and nonlinear classification models.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

Pre-Requisite(s): MA 3740 or MA 4710 or MA 4720 or MA 4780

MA 5791 - Categorical Data Analysis

Structure of 2-way contingency tables. Goodness-of-fit tests and Fisher's exact test for categorical data. Fitting models, including logistic regression, logit models, probit and extreme value models for binary response variables. Building and applying log linear models for contingency tables.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2005-2006 academic year

MA 5901 - Teaching College Mathematics I

Survey key issues in undergraduate mathematics education, including course preparation, assessment, student learning, developing assignments, instructional strategies, technology, motivating students and institutional resources. The lab involves practical training in the computer algebra system used in the mathematics lab.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Major(s): Mathematical Sciences, Statistics, Mathematics; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

MA 5904 - Teaching Online Courses

An introduction to college-level online teaching principles. Based on nationally recognized standards for online course evaluation, the course will focus on course preparation, assessment, instructional strategies to increase student learning and motivation, and the use of instructional technology to optimize an online course.

Credits: 1.0

Lec-Rec-Lab: (0-1-0)

Semesters Offered: Summer

MA 5980 - Special Topics in Mathematics

Special topics in mathematics.

Credits: variable to 12.0; Repeatable to a Max of 48

Semesters Offered: Fall, Spring, Summer

MA 5999 - Graduate Research in Mathematics

Original investigation in theoretical, or applied mathematics, and submission of a thesis in partial fulfillment of the requirements for the master's degree in mathematics.

Credits: variable to 12.0; May be repeated; Graded Pass/Fail Only

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

MA 6222 - Advanced Topics in Design Theory

Advanced topics in design theory.

Credits: 3.0; Repeatable to a Max of 48

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2011-2012 academic year

Restrictions: Permission of department required

Pre-Requisite(s): MA 5222

MA 6231 - Advanced Topics in Coding Theory

Advanced topics in coding theory.

Credits: 3.0; Repeatable to a Max of 48

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2010-2011 academic year

Restrictions: Permission of department required

Pre-Requisite(s): MA 5231

MA 6280 - Advanced Topics in Combinatorics, Algebra, or Number Theory

Advanced topics in combinatorics, algebra, or number theory.

Credits: 3.0; Repeatable to a Max of 48

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring - Offered alternate years beginning with the 2010-2011 academic year

Restrictions: Permission of department required

MA 6300 - Advanced Topics in Algebra

Advanced topics in algebra.

Credits: 3.0; Repeatable to a Max of 48

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring - Offered alternate years beginning with the 2011-2012 academic year

Restrictions: Permission of department required

Pre-Requisite(s): MA 5302

MA 6500 - Advanced Topics in Applied Mathematics

Advanced topics in applied mathematics.

Credits: 3.0; Repeatable to a Max of 48

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2011-2012 academic year

Restrictions: Permission of department required

MA 6600 - Advanced Topics in Computational Mathematics

Advanced topics in computational mathematics.

Credits: 3.0; Repeatable to a Max of 48

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2010-2011 academic year

Restrictions: Permission of department required

MA 6700 - Advanced Topics in Statistics

Topics may include but are not limited to experimental designs, methods of quality improvement, discrete data analysis, regression analysis, sampling theory, multivariate methods, resampling methods, statistical computing, integral and measure theory, stochastic processes, asymptotic methods, optimization, modeling, nonparametric and parametric statistics.
Credits: variable to 12.0; Repeatable to a Max of 48
Semesters Offered: Spring - Offered alternate years beginning with the 2010-2011 academic year
Restrictions: Must be enrolled in one of the following Level(s): Graduate

MA 6701 - Probability

Review of discrete probability, probability measures, random variables, distribution functions, expectation as a Lebesgue-Stieltjes integral, independence, modes of convergence, laws of large numbers and iterated logarithms, characteristic functions, central limit theorems, conditional expectation, martingales, introduction to stochastic processes.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall - Offered alternate years beginning with the 2011-2012 academic year
Pre-Requisite(s): MA 3720 and MA 5401

MA 6980 - Special Topics in Mathematics

Special topics in mathematics.
Credits: variable to 12.0; Repeatable to a Max of 48
Semesters Offered: Fall, Spring, Summer

MA 6999 - Mathematical Sciences Doctoral Research

Taken in partial fulfillment of the doctoral thesis requirement.
Credits: variable to 12.0; May be repeated; Graded Pass/Fail Only
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

Mechanical Engineering – Engineering Mechanics**MEEM 5010 - Professional Engineering Communication**

Course introduces graduate students to conventions of professional engineering communication such as composing technical documents and working effectively in teams. Students will practice creating effective visuals for reports and slides and develop and deliver presentations.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following College(s): College of Engineering

MEEM 5110 - Continuum Mechanics/Elasticity

Covers development of Cartesian tensors and indicial notation applied to vector analysis; analysis of stress, principal stresses, invariants, strain tensors, material derivatives, and continuity equations; basic conservation laws and constitutive relationships; the theory of elasticity, including 2-D problems in plane stress/strain, stress functions, and 3-D problems with polar symmetry.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following College(s): College of Engineering

MEEM 5130 - Nanoscale Science and Technology

The course covers fundamentals of nanoscience (synthesis, properties, characterization) and recent technological advances in renewable energy, biotechnology, and nanodevices. This course is appropriate for students with backgrounds in mechanical engineering, materials science, chemistry, chemical engineering, civil engineering, and physics.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall, Spring

MEEM 5150 - Advanced Mechanics of Mats

A study of incorporating complexities into the classical theories of axial rods, torsion of circular and non-circular shafts, bending of beams and plates. Use of variational principles to obtain boundary value problems of aforementioned structural members.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following College(s): College of Engineering

MEEM 5160 - Experimental Stress Analysis

Review of elastic stress-strain relationships. Covers theory and use of resistive strain gages, strain gage circuits, rosette analysis, static and dynamic strain measurement; discusses other current strain measuring techniques; introduces photoelasticity, Moire, and other optical techniques.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Fall
Restrictions: 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 5170 - Finite Element and Variational Methods in Engineering

Presents fundamental concepts of variational methods including Rayleigh-Ritz technique. Introduces foundations of finite element modeling through direct method, variational method, and weighted residual method. Reviews elements commonly used in static structural analysis and heat transfer problems. Advanced topics such as nonlinearity and time-dependent problems may also be discussed.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Level(s): Graduate

MEEM 5180 - Mechanics of Composite Mats

Introduces engineering properties and advantages of fibrous composites, the governing equations of mechanics of anisotropic, laminated materials. Develops micromechanics methods for predicting the elastic properties of the composite and classical lamination theory, including hygrothermal effects, and applies them to stress and failure analysis of composite structures.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring - Offered alternate years beginning with the 2009-2010 academic year
Restrictions: Must be enrolled in one of the following Level(s): Graduate

MEEM 5201 - Fundamentals of SI Engines

A combination of lab lecture and hands-on activities. Operation fundamentals, performance metrics, thermochemistry, combustion, Miller & Atkinson cycle, fuel & air system, supercharging & turbocharging, exhaust systems, energy balance, variable valve actuation, simulation, and advanced concepts & trends.
Credits: 1.0
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Summer - Offered alternate years beginning with the 2017-2018 academic year
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 5202 - Fundamentals of Diesel Engines

A combination of lab lecture and hands-on activities. Fundamentals of operation, performance metrics, thermochemistry, combustion, fuel injection and spray, air systems and turbocharging, EGR, energy balance, heat transfer, diesel engine simulation, and advanced concepts and trends in diesel engines.
Credits: 1.0
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Summer - Offered alternate years beginning with the 2018-2019 academic year
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 5203 - SI Engine Control Systems

A combination lab lecture and hands-on activities. Review engine operation, regulations, intro to engine control, sensors & actuators, causality effects, combustion phasing, lambda, valve timing, load, control of, throttle, knock, turbo, fuel, emissions control, algorithm & calibration, OBD, controller communications.
Credits: 1.0
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Summer - Offered alternate years beginning with the 2017-2018 academic year
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 5204 - Diesel Engine Control Systems

A combination of lab lecture and hands-on activities. Review diesel operation, regulations, intro to engine control, diesel engine actuators, load control, Start of Injection, Rail Pressure, Turbo Control, EGR & Engine Out Emissions, after treatment, algorithm & calibration, OBD, controller communications.
Credits: 1.0
Lec-Rec-Lab: (0-0-2)
Semesters Offered: Summer - Offered alternate years beginning with the 2018-2019 academic year
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 5210 - Advanced Fluid Mechanics

Develops control volume forms of balance laws governing fluid motion and applies to problems involving rockets, pumps, sprinklers, etc. Derives and studies differential forms of governing equations for incompressible viscous flows. Some analytical solutions are obtained and students are exposed to rationale behind computational solution in conjunction with CFD software demonstration. Also covers qualitative aspects of lift and drag, loss of stability of laminar flows, turbulence, and vortex shedding.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following College(s): College of Engineering

MEEM 5212 - Intermediate Thermodynamics

A graduate-level thermodynamics course with emphasis on chemically reacting mixtures, thermodynamic property relations, entropy production/exergy destruction, and chemical and phase equilibrium.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Mechanical Engineering, Mechanical Eng-Eng Mechanics, Engineering Mechanics

MEEM 5215 - Computational Fluids Engineering

This course introduces students into the theoretical and practical aspects of computational methods in fluid mechanics and thermal transport problems. Computer based tools are used to reinforce principles on advanced topics in thermo-fluids science.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following College(s): College of Engineering

MEEM 5220 - Fuel Cell Technology

Fuel cell basics, operation principles and advanced performance analysis. Emphasis on component materials and two-phase transport phenomena on proton exchange membrane fuel cells. Hydrogen production, transportation, and storage. Balance of plant and systems analysis.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following College(s): College of Engineering

MEEM 5225 - Advanced Power System and Pollution Control

Course will cover stationary systems for industrial and power applications; will include coal power plants, open-and combined-cycle gas turbines, co-generation, post combustion pollution control, biomass based fuels for power generation, and economic considerations.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Mechanical Engineering, Mechanical Eng-Eng Mechanics, Engineering Mechanics

MEEM 5230 - Advanced Heat Transfer

Advanced topics on conduction, convection, radiation, and heat exchangers are covered. Emphasis is on problem formulation, exact solutions, empirical correlations/results, and on computational techniques.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following College(s): College of Engineering

MEEM 5235 - Wind Energy

This course introduces students to the underlying principles of wind energy conversion, with an emphasis on the theoretical aspects of wind turbine design, aerodynamics, construction, control, and operation.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following College(s): College of Engineering

MEEM 5240 - Comp Fluid Dynamics for Engg

Introduces finite-difference and finite-volume methods used in solving fluid dynamics and heat transfer problems. Covers numerical grid generation, turbulence modeling, and application to some selected problems.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2001-2002 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): MEEM 5210

MEEM 5250 - Internal Combustion Engines II

Advanced topics in internal combustion engines with emphasis on CI operation, modeling of engines, modeling of combustion processes, tribology, second law applications, and other topics of current interest.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2001-2002 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Mechanical Engineering, Mechanical Eng-Eng Mechanics, Engineering Mechanics
Pre-Requisite(s): MEEM 4220 and (MEEM 4201(C) or MEEM 5212(C))

MEEM 5255 - Advanced Powertrain Instrumentation and Experimental Methods

Course is for those interested in experimentation, engines, and powertrain.

Objective is prepare to acquire quality data, and efficient experiments.

Investigate transducers, calibration, data acquisition, signal conditioning, noise, and specific applications; engine combustion and emissions. Hands-on homework and structured lab activities.

Credits: 3.0

Lec-Rec-Lab: (0-2-2)

Semesters Offered: Spring

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

Pre-Requisite(s): MEEM 4220(C)

MEEM 5265 - Physical Gasdynamics

Equilibrium gaskinetic theory, chemical thermodynamics, introduction to quantum and statistical mechanics, flow with finite rate (e.g. vibrational energy relaxations, and chemical reactions), nonequilibrium kinetic theory, selected gaskinetic related computational methods.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following College(s): College of Engineering

MEEM 5270 - Advanced Combustion

The objective is to understand basic combustion processes through detailed chemical reaction step analysis. Introduces both analytical and modern experimental methods. Emphasizes gas liquid fuel combustion, flame propagation, and critical phenomena of ignition and extinction.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following College(s): College of Engineering

Pre-Requisite(s): MEEM 4240 or MEEM 4201 or MEEM 5212

MEEM 5275 - Energy Storage Systems

Designing energy storage solutions for grid, vehicle, and portable/autonomous systems. Quantitative and qualitative analysis of energy storage aging, cost, and performance improvement.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Mechanical Engineering, Mechanical Eng-Eng Mechanics, Engineering Mechanics

MEEM 5280 - Phase-Change & Two-Phase Flows

Air-water, condensing, and boiling flows are discussed in the context of interface conditions and instabilities. Wettability conditions and nucleation mechanisms are considered. Two-phase flow predictions are discussed in the context of correlations for: flow-regime maps, heat transfer coefficients, pressure-drop, void-fraction, etc.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following College(s): College of Engineering

MEEM 5290 - Principles of Energy Conversion

Introduces fundamentals of energy conversion and storage. Topics includes fossil and nuclear fuels, thermodynamic power cycles, solar energy, photovoltaics, and energy storage. Students will apply energy economics and complete semester-long project.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following College(s): College of Engineering

Pre-Requisite(s): MEEM 5212(C)

MEEM 5295 - Advanced Propulsion Systems for Hybrid Electric Vehicles

Hybrid electric vehicles (HEV) will be studied and simulated using advanced powertrain component analysis and modeling. An in-depth analysis and study of power flows, losses and energy usage are examined for isolated powertrain components and HEV configurations. Simulation tools will be developed and applied to specify powertrain and vehicle components and to develop control and calibration for a constrained optimization to vehicle technical specifications.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following College(s): College of Engineering; Must be enrolled in one of the following Major(s): Mechanical Engineering, Mechanical Eng-Eng Mechanics, Engineering Mechanics
Pre-Requisite(s): MEEM 4295

MEEM 5296 - Powertrain Integration in HEV

This hands-on course examines challenges with powertrain integration in Hybrid Vehicles. Topics include Vehicle Development Process, Thermal Management, Vehicle Controls, Safety, Calibration, and Vehicle Simulation Models. The course project includes optimizing performance of a configurable HEV using modeling and experimentation.

Credits: 3.0

Lec-Rec-Lab: (0-2-2)

Semesters Offered: Spring, Summer

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following College(s): College of Engineering
Pre-Requisite(s): MEEM 4296(C) or EE 4296(C)

MEEM 5300 - Cybersecurity of Industrial Control Systems

General introduction to cybersecurity of industrial control systems and critical infrastructures. Topics include NIST and DHS publications, threat analysis, vulnerability analysis, red teaming, intrusion detection systems, industrial networks, industrial malware, and selected case studies.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Mechanical Engineering, Mechanical Eng-Eng Mechanics, Engineering Mechanics

MEEM 5315 - Cyber Security of Automotive Systems I

Modern automotive control and communications systems from a cyber security perspective. Topics include: V2X communications, vehicle attack surfaces and vulnerabilities, in-vehicle networks, threat analysis and vulnerabilities, security mechanisms and architectures, security requirements analysis, hardware security modules, and standards.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Computer Science, Mechanical Engineering, Mechanical Eng-Eng Mechanics, Computer Engineering, Electrical Engineering
Pre-Requisite(s): MEEM 5300 or EE 5455

MEEM 5401 - Design for Reliability

Emphasizes the importance of reliability in design, covering basic concepts of series, parallel, standby and mixed systems. Uses conditional probability and multimodefuctions as methods for problem solution. Considers derating and reliability testing.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate

MEEM 5430 - Human Factors - Transportation

This course aims to provide an understanding of drivers as a system component in the operation of vehicles and other transportation systems. Topics covered include human factors, driver-vehicle interaction, intelligent transportation systems, connected vehicle technology, and user interface.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Major(s): Mechanical Engineering, Mechanical Eng-Eng Mechanics, Engineering Mechanics; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

MEEM 5440 - Advanced Vehicle Dynamics

This course will develop advanced nonlinear models to predict vehicle dynamic response of road vehicles by means of Matlab Simulink environment. Topics covered by this course include advanced tire modeling, powertrain modeling, lateral dynamics and vertical dynamics.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Summer

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Mechanical Eng-Eng Mechanics, Engineering Mechanics, Mechanical Engineering, Computer Engineering, Electrical Engineering

MEEM 5610 - Advanced Machining Processes

Covers mechanics of 2-D and 3-D cutting and their extension to commonly used processes such as turning, boring, milling, and drilling. Topics include force modeling, surface generation, heat transfer, tool life and dynamics.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following College(s): College of Engineering

MEEM 5615 - Advanced Metal Forming

Introduces fundamentals of plasticity theory and applies to the analysis of deformation processes. Processes considered are forging, extrusion, wire drawing, bending, deep drawing, and stretch forming. Emphasizes sheet metal formability.

Credits: 4.0

Lec-Rec-Lab: (0-3-2)

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following College(s): College of Engineering

MEEM 5625 - Precision Manuf and Metrology

Presents theory and practice involved in the manufacturing and measuring of precision components. Topics include precision machining processes, precision machine/mechanism design, and dimensional metrology. Addresses current manufacturing challenges in the bearings, optics, and microelectronics industries.

Credits: 3.0

Lec-Rec-Lab: (0-2-2)

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Mechanical Engineering, Mechanical Eng-Eng Mechanics, Engineering Mechanics

MEEM 5640 - Micromanufacturing Processes

Introduction, analysis and reporting of 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

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Mechanical Engineering, Mechanical Eng-Eng Mechanics, Engineering Mechanics

MEEM 5645 - Numerical Analy Manuf Proc

Nonlinear FEM and BEM analyses, modeling of bulk forming processes, sheet forming processes, machining processes, casting processes, grinding of ceramics.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following College(s): College of Engineering

MEEM 5650 - Advanced Quality Engineering

Stresses the concepts and methods for quality and productivity improvement. Topics include principles of Shewhart, Deming, Taguchi; meaning of quality: control charts for variables, individuals, and attributes; process capability analysis; variation of assemblies; Monte Carlo simulation, multi-variate situations; and computer-based workshops. No credit for both MEEM4650 and MEEM5650.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following College(s): College of Engineering

MEEM 5655 - Introduction to Lean Manufacturing

Lean manufacturing is emerging globally as a paradigm by which business units must function to be globally competitive. Quality, cost, and delivery have become critical measures that impact profits and, in turn, the success of an organization. Significant improvements in all these three measures come from the continuous elimination of waste, or non-value added activities, in manufacturing. Numerous tools are available for the elimination of waste and making businesses lean. This course is intended to familiarize students with this new philosophy of lean manufacturing and arm them with a basic toolset that enables the identification, measurement, and elimination of non-value added activities.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring, Summer - Offered alternate years beginning with the 2007-2008 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following College(s): College of Engineering, School of Business & Economics

MEEM 5670 - Experimental Design in Engg

Review of basic statistical concepts. Models for testing significance of one or many factors. Reducing experimental effort by incomplete blocks, and Latin squares. Factorial and fractional factorial designs. Response surface analysis for optimal response.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate

MEEM 5680 - Optimization I

Provides introductory concepts to optimization methods and theory. Covers the fundamentals of optimization, which is central to any problem involving engineering decision making. Provides the tools to select the best alternative for specific objectives.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

MEEM 5685 - Environmentally Responsible Design and Manufacturing

Examines impact of engineering and, in particular, design/manufacturing decisions on the environment. Topics include sustainability; energy/material flows; risk assessment, life cycles, manufacturing process waste streams, product design issues, including disassembly/post-use product handling; techniques for pollution prevention. Requires course project. Credit may not be received for both MEEM4685 and MEEM5685.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring - Offered alternate years beginning with the 2001-2002 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

MEEM 5695 - Additive Manufacturing

Background, principles, process chain, software aspects, post-processing, open-source tools, applications, and future directions of AM technologies are discussed. Advanced topics include process modeling and selection, DFAM, and opportunities and challenges of AM processes.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

MEEM 5700 - Dynamic Measurement/Signal Analysis

Assessment of measurement system requirements: transducers, conditioners, and displays of dynamic measurands. Time-, frequency-, probabilistic-, and correlative-domain approaches to dynamic signal analysis: sampled data, discrete Fourier transforms, digital filtering, estimation errors, system identification, calibration, recording. Introduction to wavelet analysis. All concepts reinforced in laboratory and simulation exercises.

Credits: 4.0

Lec-Rec-Lab: (0-3-3)

Semesters Offered: Fall, Summer

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following College(s): College of Engineering

MEEM 5701 - Intermediate Dynamics

Intermediate study of several topics in engineering dynamics, including three-dimensional kinematics and kinetics, generalized coordinates, Lagrange's equation, and Hamilton's principle. Uses computer-aided dynamic simulation tools for analyzing dynamic systems.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Mechanical Engineering, Mechanical Eng-Eng Mechanics, Engineering Mechanics

MEEM 5702 - Analytical Vibroacoustics

First in a series of two courses on vibro-acoustics to provide a unified approach to study noise and vibration. Emphasizes interaction between sound waves and structures. Presents advanced vibration concepts with computational tools. Discusses wave-modal duality.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Mechanical Engineering, Mechanical Eng-Eng Mechanics, Engineering Mechanics

MEEM 5703 - Exp Methods Vibro-Acoustics

Covers operating data measurement and analysis, including multisource ODS. Includes signature analysis and order tracking; modal theory, modal scaling. FRF estimators; multiple input excitation techniques; parameter estimation methods; sound measurements and acoustic intensity; sound quality; field data acquisition, DAT; binaural recording and playback with equalization.

Credits: 4.0

Lec-Rec-Lab: (0-3-3)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): MEEM 5700 and MEEM 5702

MEEM 5705 - Introduction to Robotics and Mechatronics

Cross-discipline system integration of sensors, actuators, and microprocessors to achieve high-level design requirements, including robotic systems. A variety of sensor and actuation types are introduced, from both a practical and a mathematical perspective. Embedded microprocessor applications are developed using the C programming language. A final project is required including analysis, design, and experimental demonstration. Cannot receive credit for both MEEM4705 and MEEM5705.

Credits: 4.0

Lec-Rec-Lab: (0-3-3)

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Mechanical Engineering, Mechanical Eng-Eng Mechanics, Engineering Mechanics
Pre-Requisite(s): MEEM 3750

MEEM 5715 - Linear Systems Theory and Design

Overview of linear algebra, modern control; state-based design of linear systems, observability, controllability, pole placement, observer design, stability theory of linear time-varying systems, Lyapunov stability, optimal control, linear quadratic regulator, Kalman filter,

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Mechanical Engineering, Mechanical Eng-Eng Mechanics, Engineering Mechanics
Pre-Requisite(s): MEEM 3750 or EE 3261

MEEM 5720 - Advanced Space Mechanics

This course presents the vector-based solution of the two-body problem and the solution for Kepler's equations. The course will also cover basic orbit determination techniques, impulsive orbit transfer maneuvers, interplanetary trajectories, ground tracks, and rendezvous problems.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following College(s): College of Engineering

MEEM 5750 - Model-Based Embedded Control System Design

This course introduces embedded control system design using model-based approach. Course topics include model-based embedded control system design, discrete-event control, sensors, actuators, electronic control unit, digital controller design, and communications protocols. Prior knowledge of hybrid electric vehicles are highly recommended.

Credits: 3.0

Lec-Rec-Lab: (0-2-2)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following College(s): College of Engineering; Must be enrolled in one of the following Major(s): Mechanical Engineering, Mechanical Eng-Eng Mechanics, Engineering Mechanics
Pre-Requisite(s): (MEEM 4700 or MEEM 4775 or EE 4261 or EE 3261) and MEEM 4295

MEEM 5800 - Advanced Engineering Mathematics with Applications

This course is for engineering graduate students to learn about in-depth ordinary differential equations (ODEs) and partial differential equations (PDEs) widely employed in the field of Mechanical Engineering. 'Vector Calculus' will also be covered. The students will be asked to demonstrate their knowledge of the material covered in this Advanced Engineering Mathematics course.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Mechanical Engineering, Mechanical Eng-Eng Mechanics, Engineering Mechanics

MEEM 5811 - Automotive Systems

Automotive systems for light duty vehicles are examined from the perspectives of requirements, design, technical, and economic analysis for advanced mobility needs. This course links the content for the automotive systems graduate certificate in controls, powertrain, vehicle dynamics, connected and autonomous vehicles.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Mechanical Eng-Eng Mechanics, Automotive Systems & Controls, Engineering Mechanics, Mechanical Engineering

MEEM 5812 - Automotive Control Systems

Introduction to automotive control systems. Modeling and control methods are presented for: air-fuel ratio, transient fuel, spark timing, idle speed, transmission, cruise speed, anti-lock brakes, traction, active suspension systems, and hybrid electric vehicles. Advanced control methodologies are introduced for appropriate applications.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Mechanical Engineering, Mechanical Eng-Eng Mechanics, Engineering Mechanics

Pre-Requisite(s): MEEM 4700 or MEEM 4775

MEEM 5990 - Special Topics

Study of selected subjects related to mechanical engineering or engineering mechanics.

Credits: variable to 3.0; May be repeated

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

MEEM 5994 - International Mechanical Engineering Field Experience

Field work and reporting from students in the Peace Corps Master's International Program in Mechanical Engineering.

Credits: 1.0; May be repeated

Lec-Rec-Lab: (0-0-2)

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Mechanical Engineering

MEEM 5995 - Graduate Research (Online/Off Campus)

Research/investigation on a topic related to mechanical engineering or engineering mechanics leading to the submission of a thesis or report in a partial fulfillment of the requirements for the master's degree.

Credits: variable to 15.0; May be repeated; Graded Pass/Fail Only

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Mechanical Engineering, Mechanical Eng-Eng Mechanics, Engineering Mechanics

MEEM 5999 - Graduate Research

Research/investigation on a topic related to mechanical engineering or engineering mechanics leading to the submission of a thesis or report in partial fulfillment of the requirements for the master's degree.

Credits: variable to 15.0; May be repeated; Graded Pass/Fail Only

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Mechanical Engineering, Mechanical Eng-Eng Mechanics, Engineering Mechanics

MEEM 6000 - Graduate Seminar

Presentations/seminars on issues related to mechanical engineering and engineering mechanics. May include invited speakers from industry, government labs, and academe.

Credits: 1.0; Repeatable to a Max of 2

Lec-Rec-Lab: (0-1-0)

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

MEEM 6010 - Engineering Research Communications

Guides students through the process of preparing proposals, publishing research, and presenting at conferences and other venues, with a focus on practical application of rhetorical concepts. Students will prepare proposals, papers, and presentations related to their own research.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following College(s): College of Engineering

MEEM 6110 - Advanced Continuum Mechanics

Presents fundamental concepts in hyperelasticity, damage mechanics, linear viscoelasticity, quasi-linear viscoelasticity, poroelasticity, continuum jump conditions, plasticity, and viscoplasticity. These theories are applied to describe the mechanical behavior of a wide range of engineering materials and biomaterials such as polymers, metals, soil, collagen, muscle tissue, bone tissue, and cartilage.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2008-2009 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following College(s): College of Engineering

Pre-Requisite(s): MEEM 5110

MEEM 6120 - Dynamic Behavior of Materials

Covers the dynamic stress-strain aspects of material behavior, discusses elastic waves in bounded media, describes the Hopkinson bar, an experimental tool for the determination of the dynamic strength of materials, and includes impacts of bars and response of high strain rate.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand - Offered alternate years beginning with the 2001-2002 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following College(s): College of Engineering

MEEM 6130 - Engineering Fracture Mechanics

Development of the stress and deformation fields present near the tips of cracks. Uses elasticity solutions, plasticity corrections, and numerical methods in modeling these fields. Introduces fracture criteria and explains the various parameters used to develop these criteria.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring, Summer - Offered alternate years beginning with the 2008-2009 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Mechanical Engineering, Mechanical Eng-Eng Mechanics, Engineering Mechanics

MEEM 6212 - Advanced Thermodynamics

This course includes classical (equilibrium) thermodynamics and statistical mechanics. Topics include thermodynamic potentials, state relations, statistical mechanics, stability, chemical equilibrium and reaction kinetics, phase equilibrium, and non-equilibrium phase change. Objectives are to develop a deeper understanding of thermodynamic methods.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Pre-Requisite(s): MEEM 5212

MEEM 6230 - Conduction

Fundamental aspects of conductive heat transfer applied to steady-state and transient conditions. Studies multidimensional conduction problems with exact and approximate solutions techniques.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): MEEM 5230

MEEM 6240 - Convective Heat Transfer

An introduction to flow and boundary layer theory for forced and natural convection heat and mass transfer. Includes derivation and application of the equations for conservation of mass, energy, and momentum; dimensional analysis and correlation of experimental results.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): MEEM 5230

MEEM 6250 - Radiative Heat Transfer

Fundamentals of thermal radiation for black, gray, nongray, diffuse, and specular surfaces. Includes radiation combined with conduction and convection at boundaries; properties for radiation in absorbing, emitting, and scattering media; and the engineering treatment of gas radiation in enclosures.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): MEEM 5230

MEEM 6320 - Cyber Security of Automotive Systems II

This course covers advanced topics in cyber security of automotive systems. Topics covered include modeling and simulation of cyber attacks on vehicle subsystems, communications, security for V2X systems, vulnerabilities in cooperative vehicle infrastructures, threat analysis, and cyber security of SAE level 2, 3, and 4 autonomous driving systems.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Computer Science, Mechanical Engineering, Mechanical Eng-Eng Mechanics, Computer Engineering, Electrical Engineering

Pre-Requisite(s): MEEM 5310 or EE 5310

MEEM 6701 - Advanced Acoustics

Advanced concepts in acoustics with emphasis on modeling of sound sources, sound interaction with solid structures, transmission and radiation of sound. Discusses numerical acoustics, statistical energy analysis, and sound quality concepts. Provides beneficial background in basic vibrations and noise control.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): MEEM 4704

MEEM 6702 - Nonlinear Sys Analy & Control

Studies nonlinear systems from perspective of analysis/control system design. Explores fundamental properties for nonlinear differential equations in addition to describing functions, phase plane analysis, stability/instability theorems. Develops and applies control system design approaches for nonlinear systems, including feedback linearization and sliding mode control.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): MEEM 5715

MEEM 6703 - Advanced Vibrations

Free and forced vibration of continuous systems with applications to strings, shafts, beams, plates and membranes. Problems formulated using Hamilton's principle and Lagrange's equations. Approximate methods of solution include the Rayleigh-Ritz method and Galerkin's method.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Mechanical Engineering, Mechanical Eng-Eng Mechanics, Engineering Mechanics

MEEM 6990 - Special Topics

Study of selected subjects related to mechanical engineering or engineering mechanics.
Credits: variable to 6.0; May be repeated
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

MEEM 6995 - Graduate Research (Online/Off Campus)

Research/investigation on a topic related to mechanical engineering or engineering mechanics leading to the submission of a dissertation in partial fulfillment of the requirements for the PhD degree.
Credits: variable to 15.0; May be repeated; Graded Pass/Fail Only
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Mechanical Eng-Eng Mechanics

MEEM 6999 - Doctoral Research

Research/investigation on a topic related to mechanical engineering or engineering mechanics leading to the submission of a dissertation in partial fulfillment of the requirements for the PhD degree.
Credits: variable to 15.0; May be repeated; Graded Pass/Fail Only
Semesters Offered: Fall, Spring, Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate

Mechanical Engineering Technology**MET 5000 - Independent Study in Mechanical Engineering Technology**

Independent study in an approved topic under the guidance of a Mechanical Engineering Technology faculty member. Course of study may either be research or academic determined by student and faculty.
Credits: variable to 3.0; Repeatable to a Max of 6
Semesters Offered: On Demand
Restrictions: Permission of instructor required; Must be enrolled in one of the following Class(es): Senior

MET 5378 - Advanced Hydraulics: Electro-hydraulic Components & Systems

This course covers electro-hydraulic components including solenoid operated valves, proportional valves, and servo valves. Also covered are hydraulic systems including open-loop and closed-loop.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): MET 4377

MET 5800 - Dynamics and Kinetics of Robotics Platforms

This course covers the dynamics and kinematics of rigid bodies as the foundation for analyzing the motion of robots. Robotic kinematics is reviewed by analyzing the motion of the robot. The dynamics is reviewed by analyzing the relation between the joint actuator torques and resulting motion.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Spring
Pre-Requisite(s): MET 2130 or MET 3130

MET 5801 - Controls of Dynamics Systems

This course covers the modeling, analysis, and control of dynamic systems. It used the controlling equations for the control of mechanical and electrical systems. Theory is verified with simulation and lab testing. Included is a major project with a report and presentation on the subject.
Credits: 3.0
Lec-ec-Lab: (0-2-2)
Semesters Offered: Fall
Pre-Requisite(s): MET 4800 or MET 5800

MET 5802 - Vibrations of Mechanical Systems

This course deals with the modeling and analysis of mixed physical systems. Introduction to modeling and oscillatory response analysis for discrete and continuous mechanical and structural systems. Time and frequency domain analysis of linear system vibrations. Vibration of multi-degree-of-freedom systems. Free vibration eigenvalue problems.
Credits: 3.0
Lec-Rec-Lab: (0-3-0)
Semesters Offered: Fall
Pre-Requisite(s): MET 2130

MET 5990 - Special Topics in Mechanical Engineering Technology

Mechanical Engineering Technology topics of interest to faculty and student.
Credits: variable to 3.0; Repeatable to a Max of 12
Semesters Offered: Fall, Spring, Summer
Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

Materials Science & Engineering**MSE 5100 - Introduction to Materials Science and Engineering with Advanced Topics**

A survey of the processing structure property relationships including metals, ceramics, and polymers. The course will cover the same material as in MY2100 plus advanced topics on materials structure, characterization, processing, and properties.
Credits: 4.0
Lec-Rec-Lab: (4-0-0)
Semesters Offered: Summer
Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Materials Science and Engrg

MSE 5102 - Advanced Concrete Materials

Properties and applications of portland cement and portland cement concrete. Includes cement production, chemistry and hydration, concrete admixtures, and the properties of fresh and hardened concrete. Presents concrete microstructure and durability. Other topics include high-strength and high early-strength concrete, fiber-reinforced concrete, and advanced cement-based materials.
Credits: 3.0
Lec-Rec-Lab: (0-2-2)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate

MSE 5110 - Thermodynamics and Kinetics I

Solution thermodynamics and application to phase equilibria. Driving force for phase transformations. Chemical thermodynamics applied to materials processing. Corrosion and oxidation of metals. Applications to engineering situations.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Fall
Restrictions: Must be enrolled in one of the following Level(s): Graduate

MSE 5120 - Thermodynamics and Kinetics II

The kinetics of liquid-to-solid and solid-to-solid phase transformations. Diffusion-controlled phase transformations, including nucleation, growth, coarsening, spinodal decomposition, eutectic and eutectoid transformations, cellular transformations, and massive transformations. Martensitic transformations.
Credits: 3.0
Lec-Rec-Lab: (3-0-0)
Semesters Offered: Spring
Restrictions: Must be enrolled in one of the following Level(s): Graduate
Pre-Requisite(s): MY 5100 or MSE 5110

MSE 5130 - Crystallography & Diffraction

Crystallographic concepts and diffraction analyses in materials science.
Credits: 3.0
Lec-Rec-Lab: (2-0-3)
Semesters Offered: On Demand
Restrictions: Must be enrolled in one of the following Level(s): Graduate

MSE 5140 - Mechanical Behavior of Materials

Deformation-related physical behaviors of materials in the mathematical framework of tensor analysis. Material symmetry and tensor property. Stress, strain, and elastic constitutive relation. Non-elastic strain, thermomechanical, electromechanical, and magnetomechanical behaviors.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

MSE 5190 - Advanced Materials Processing for Mechanical, Energy, and Biomedical Applications

Advanced materials processing technologies will be instructed with examples of various applications in mechanical, energy, and biomedical areas. Powder production, surface chemistry, separation, agglomeration, composites, forming, shaping, conventional and microwave heating, and nano materials and structures will be introduced.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2014-2015 academic year

Restrictions: Must be enrolled in one of the following College(s): College of Engineering; May not be enrolled in one of the following Class(es): Freshman, Sophomore

MSE 5410 - Materials for Energy Applications

Advanced solid materials for hydrogen energy will be introduced, including hydrogen storage materials, hydrogen production catalysts, and proton exchange membranes with emphasis on structures and properties. Silicon semiconductors, compound semiconductors, and nanostructured semiconductors will be discussed for solar energy applications.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

MSE 5430 - Electronic Materials

A study of the physical principles, operational characteristics, models, and basic applications of selected solid-state devices.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate

MSE 5440 - Materials Recycling: Processing and Utilization

Methods for materials recycling is the emphasis. Topics include the recycling of materials for steel, aluminum, automobile, foundry, glass, plastics, energy, construction, and other industries. Background of the industry, characteristics of materials, materials flow, and the processing and utilization methods to recycle the materials are presented.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

MSE 5460 - Solid State Devices

A study of the physical principles, operational characteristics and models and basic applications of solid state devices such as p-n junctions, metal-semiconductor junctions and transistors.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring

MSE 5470 - Semiconductor Fabrication

Graduate level introduction to the science and engineering of semiconductor device fabrication.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

MSE 5480 - Advanced MEMS

This course will cover advanced topics dealing with MEIXIS technologies, transduction mechanisms, and microfabricated sensors and actuators and is continuation of EE4240/MY4240.

Credits: 4.0

Lec-Rec-Lab: (3-1-0)

Semesters Offered: Spring

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

Pre-Requisite(s): EE 4240 or MY 4240 or MSE 4240

MSE 5490 - Solar Photovoltaic Science and Engineering

Solar photovoltaic materials, the device physics of photovoltaic cells and practical applications of solar electric systems engineering.

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 Level(s): Graduate

MSE 5510 - Advanced Contact Mechanics and Nanoindentation

The application of elastic and plastic contact mechanics in relation to nanoindentation with emphasis on the application of instrumentation, models and experimental techniques used to examine the small-scale mechanical behavior of metals, ceramics, polymers, composites, biomaterials, hydrogels, and structured devices.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

MSE 5540 - Advanced Computational Materials Science: Theory, Modeling, Simulation, and Practice

Theories of materials science from first principles to constitutive laws. Materials modeling and computer simulation at multiple length and time scales. Laboratory practice of various computational methods.

Credits: 3.0

Lec-Rec-Lab: (2-0-3)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

MSE 5550 - Transmission Electron Microscopy

Practical aspects of materials characterization by transmission electron microscopy.

Credits: 3.0

Lec-Rec-Lab: (2-0-3)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

MSE 5580 - Introduction to Scanning Probe Microscopy

Students will learn basics of design and fundamental physics behind the scanning probe microscopy techniques. The lectures will also discuss analysis of the solid surfaces regarding roughness, topography, composition, heterogeneity, and adhesion properties using atomic force microscopy (AFM). Artifacts associated with inappropriate conditions in atomic AFM imaging will be discussed as well. Training in the operation of the AFM instrument and exploration of its capability during the laboratory sessions will complement the lectures.

Credits: 2.0

Lec-Rec-Lab: (1-0-3)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate

MSE 5610 - Powder Processing

Processing of metal and ceramic powders into bulk products. Powder manufacture and characterization, compaction, sintering, pressure-assisted consolidation to full density. Emphasis on principles underlying consolidation practices.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand - Offered alternate years beginning with the 2005-2006 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

Pre-Requisite(s): MY 2100 or MSE 2100

MSE 5621 - Open Source Scientific Hardware

This course provides an introduction to the use of distributed digital manufacturing of open source hardware for scientific and engineering applications. The course outcome will be a design of an open hardware tool.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

MSE 5665 - Surface and Interface Science for Chemical and Materials Analysis

Coursework and hands-on laboratory experiences explore physical and chemical properties governing surface processes and the appropriate analysis techniques used to study interfaces and surface chemical reactions. Topics include principles of physical chemistry and materials science for understanding and applying modern surface analysis.

Credits: 3.0

Lec-Rec-Lab: (2-0-3)

Semesters Offered: On Demand

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

MSE 5760 - Vehicle Battery Cells and Systems

The behavior and application of batteries will be examined by introducing concepts from thermodynamics, materials science, transport processes and equivalent circuits. The non-ideal power source behavior of rechargeable batteries in applications will be treated using electrolyte: electrode transport and electrode materials chemistry. Prior exposure to freshman chemistry, elementary electrical circuits, and elementary transport theory is assumed.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2010-2011 academic year

Restrictions: Must be enrolled in one of the following College(s): College of Engineering; Must be enrolled in one of the following Major(s): Biomedical Engineering, Engineering, Civil Engineering, Chemical Engineering, Computer Engineering, Electrical Engineering, Engineering Mechanics, Environmental Engineering, Geological Engineering, Geology, Mechanical Engineering, Materials Science and Engrg, Applied Physics, Chemistry, Physics, Applied Geophysics; May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

MSE 5777 - Advanced Open-Source 3-D Printing

An introduction to distributed additive manufacturing using open-source 3-D printing. Design, use, and maintenance of open-source electronics and self-replicating rapid prototypers (RepRap). Graduate students will be expected to complete coursework and an in-depth project.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following College(s): College of Engineering

MSE 5900 - Graduate Professional Preparation

Graduate student presentations at departmental seminars.

Credits: 1.0; May be repeated

Lec-Rec-Lab: (0-1-0)

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Level(s): Graduate

MSE 5970 - Special Topics - Graduate Materials Science and Engineering

Special Topics in Materials Science and Engineering at the Graduate level.

Credits: variable to 4.0; Repeatable to a Max of 8

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

MSE 5990 - MS Thesis Research

Fundamental and applied research in metallurgical and materials engineering. Taken by graduate students in partial fulfillment of the MS thesis requirements.

Credits: variable to 12.0; May be repeated; Graded Pass/Fail Only

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Level(s): Graduate

MSE 6110 - Advanced Topics in Materials Processing

Advanced treatment of various unit operations of materials processing.

Operations may include deformation processing, powder and particulate technology, solidification processing, thermomechanical processing, optimum process selection, etc.

Credits: variable to 4.0; May be repeated

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

MSE 6200 - Advanced Topics in Materials Characterization

Advanced concepts in materials characterization. Specific course content is tailored to meet the interests of the students and faculty.

Credits: variable to 4.0; May be repeated

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

MSE 6400 - Advanced Topics in Mechanical Behavior of Materials

Advanced concepts in mechanical behavior of materials. Specific course content is tailored to meet the interests of the students and faculty.

Credits: variable to 4.0; May be repeated

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

MSE 6990 - PhD Thesis Research

Fundamental and applied research in metallurgical and materials engineering.

Taken by graduate students in partial fulfillment of the PhD thesis requirements.

Credits: variable to 12.0; May be repeated; Graded Pass/Fail Only

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Physics

PH 5010 - Graduate Journal Club

Presentation and discussion of current issues in physics and recent research by departmental faculty and others. One credit in journal club is required for all graduate degrees in physics. Attendance is required in the physics department colloquium series.

Credits: 1.0

Lec-Rec-Lab: (0-1-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

PH 5090 - Special Topics in Physics

The subject matter may vary from term to term and year to year depending on the needs of advanced students.

Credits: variable to 3.0; May be repeated

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Level(s): Graduate

PH 5110 - Classical Mechanics

Lagrangian methods, symmetries and conservation laws, variational formulation, small oscillations, Hamilton's equations, contact transformations, Poisson brackets, Hamilton-Jacobi theory, Lorentz-invariant formulation.

Credits: 2.0

Lec-Rec-Lab: (2-0-0)

Semesters Offered: Fall, Spring - Offered alternate years beginning with the 2002-2003 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

PH 5151 - Quantum Field Theory for Photonics and Materials

This course will review the basics of quantum mechanics and second quantization, and cover quantum field theoretical methods, including Wick's theorem and Feynman diagram techniques, for absolute zero and non-zero temperatures (Matsubara frequencies) and their application in photonics, properties of materials and condensed matter physics.

Credits: 2.0; Graded Pass/Fail Only

Lec-Rec-Lab: (2-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2020-2021 academic year

Pre-Requisite(s): PH 3410 and PH 3411(C)

PH 5210 - Electrodynamics I

Electrostatics and magnetostatics, boundary value problems, multipoles, Maxwell's equations, time-dependent fields, propagating wave solutions, radiation.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): PH 5320

PH 5211 - Electrodynamics II

Scattering and diffraction, special relativity, relativistic particle dynamics, Lorenz transformation, 4-vectors, transformation of fields, charges and currents, Thomas precession, retarded potentials, radiation from moving charges.

Credits: 2.0

Lec-Rec-Lab: (2-0-0)

Semesters Offered: On Demand - Offered alternate years beginning with the 2008-2009 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): PH 5210

PH 5310 - Statistical Mechanics

Ensembles, partition functions and distributions, thermodynamic potentials, quantum statistics, ideal and nonideal gases, interacting systems. Applications may include classical and quantum liquids, phase transitions and critical phenomena, correlation functions, linear response and transport theory, or other topics.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2007-2008 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

PH 5320 - Mathematical Physics

Partial differential equations of physics, separation of variables, boundary value problems, Sturm-Liouville theory, Legendre and Bessel functions, inhomogeneous partial differential equations, Green's functions. Fourier series, Fourier and Laplace transforms, complex variables, evaluation of integrals by contour integration, linear algebra, matrix methods with emphasis on numerical applications.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate

PH 5390 - Scientific Computing

Set in a Linux environment, course offers exposure to Foss tools for developing computational and visualization workflows. Students will learn to translate problems into programs, understand sources of errors, and debug, improve the performance of and parallelize the code.

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; Must be enrolled in one of the following Major(s): Physics, Applied Physics

PH 5410 - Quantum Mechanics I

Study of the postulates of quantum mechanics framed in Dirac notation, the Heisenberg uncertainty relations, simple problems in one dimension, the harmonic oscillator, the principles of quantum dynamics, rotational invariance and angular momentum, spherically symmetric potentials including the hydrogen atom, and spin.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate

PH 5411 - Quantum Mechanics II

Continuation of PH5410. Includes the study of symmetries and their consequences, the variational method, identical particles, the Hartree-Fock approximation time-independent perturbation theory, time-dependent perturbation theory, diatomic molecules with applications to H₂⁺, many-body perturbation theory, and the Dirac equation.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): PH 5410

PH 5510 - Theory of Solids

Free electron theory, Bloch's theorem, electronic band structure theory, Fermi surfaces, electron transport in metals and semiconductors. Lattice vibrations and phonons, other topics as time permits.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2000-2001 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): PH 5320 and PH 5410

PH 5520 - Materials Physics

Materials classification and structures; phase diagrams; lattice imperfections; quasiparticles; boundaries and interfaces; mechanical, electronic, optical, magnetic and superconducting properties of materials.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2001-2002 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

PH 5530 - Selected Topics in Nanoscale Science and Technology

Presentation and discussion of selected topics in nanoscale science and engineering. Topics include growth, properties, applications, and societal implication of nanoscale materials. Evaluation: attendance and assignment.

Credits: 2.0

Lec-Rec-Lab: (2-0-0)

Semesters Offered: On Demand

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

PH 5640 - Atmospheric Physics

Essential elements of atmospheric physics, including thermodynamics (e.g. adiabatic processes, phase transformations, stratification), aerosol and cloud physics (e.g. nucleation, Kohler theory, growth by condensation and collection), and radiative transfer (e.g. Beer's law, transfer equations with and without scattering).

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2008-2009 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): PH 2300 and (MA 3520 or MA 3521 or MA 3530 or MA 3560)

PH 5680 - Geophysical Fluid Dynamics

Fundamental forces and conservation laws that govern fluid flow; applications to the atmosphere and ocean, including balanced flow (pressure gradient and Coriolis force), vorticity dynamics, turbulence, waves, and boundary layers.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2017-2018 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

Pre-Requisite(s): PH 2300 and (MA 3520 or MA 3521 or MA 3530 or MA 3560)

PH 5999 - Master's Research

Master's-level research conducted under the direction of a graduate faculty advisor. Attendance is required in the physics department colloquium series.

Credits: variable to 12.0; May be repeated; Graded Pass/Fail Only

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Physics, Applied Physics

PH 6999 - Doctoral Research

Independent research conducted in partial fulfillment of the requirements for the PhD degree. Scheduled by arrangement. Attendance is required in the physics department colloquium series.

Credits: variable to 12.0; May be repeated; Graded Pass/Fail Only

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor and department required; Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Physics, Applied Physics

Psychology**PSY 5001 - Tools of the Profession**

Review of professional practices and tools including APA formatting, commonly used experimental programming software, review of statistical programs, equipment training, responsible conduct of research, and IRB applications, journals and conferences, and other professional expectations/resources.

Review of departmental and university expectations, resources, and services.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

PSY 5010 - Cognitive Psychology

A systematic survey of classical and contemporary research topics in human cognition, including perception, attention, mental representation and processing, memory, knowledge, visual imagery, problem solving, reasoning, and decision making. Students will read original research papers and develop a research proposal.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate

PSY 5015 - Cognitive Task Analysis Methods

Cognitive task analysis is a group of methods to model how experts do their work to design new human-machine systems, knowledge management systems, and use cases for new tools. Students will learn several CTA methods including knowledge audit, cognitive walk walk, and critical decision method.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2017-2018 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

PSY 5020 - Research Methods

This course provides a foundation in research methods in cognitive science and human factors, with an emphasis on experimental design, research ethics, and scientific communication. Course meets Michigan Tech's Advanced Responsible Conduct of Research (RCR) requirements.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

PSY 5095 - Practicum

Independent activity where students apply their existing knowledge, skills, and methods already acquired in the program and demonstrate acquisition of new design-based knowledge, skills, and methods from the operational setting in which the practicum takes place.

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 Level(s): Graduate

PSY 5100 - Applied Cognitive Science

Survey of applied human information processing literature, detailed review of recent developments in applied cognitive science, and examination of the purposes, role and scope of cognitive systems engineering.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2017-2018 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

PSY 5160 - Sensation and Perception

This course will investigate sensory mechanisms and perceptual interpretations of the sensory stimuli. In addition to the basic five senses, proprioception, pain perception, and time perception will also be covered. Students will also write a research proposal.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

PSY 5170 - Human Attention

This course will examine theories and empirical findings from the study of human attention and consider their implications for human performance in real-world contexts.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2019-2020 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

PSY 5210 - Advanced Statistical Analysis and Design I

An overview of data analysis methods including visualization, data programming, and univariate statistics such as t-test and ANOVA.

Credits: 3.0

Lec-Rec-Lab: (0-2-1)

Semesters Offered: Fall - Offered alternate years beginning with the 2018-2019 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

PSY 5220 - Advanced Statistical Analysis and Design II

Course covers multivariate statistics such as ANCOVA, Multiple Regression, factor analysis, clustering, machine learning, and mixture modeling.

Credits: 3.0; Repeatable to a Max of 12

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2018-2019 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): PSY 5110

PSY 5390 - Testing and Measurement Advanced Psychometrics

Provides an advanced foundation in concepts, theories, and methods of psychological testing and measurement. Topics include: validity and reliability, cognitive process-tracing, test construction, survey construction, and evaluation, data analysis and interpretation, applications in human factors, workplace, neuropsychological, and educational contexts, test administration, ethics, laws, and standards. Satisfies some requirements for professional administration of psychological and educational assessments.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand

Pre-Requisite(s): PSY 5210

PSY 5410 - Computational and Mathematical Models of Human Cognition and Behavior

This course focuses on analysis and use of computational and mathematical models of human cognition and behavior. Topics include models of memory, learning, information theory, decision making, vision, semantics, production systems, game theory, and network analysis.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand

PSY 5450 - Aging, Cognition, and Motor Behavior

Seminar on current research on age-related changes in cognitive function, motor behavior, and the interaction between cognitive decline and motor performance.

Topics include the impact of aging on memory, attention, cognitive control, gait, balance, and motor learning.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2018-2019 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

PSY 5500 - Supervised Teaching Practicum

An experiential course in which student gain practical experience with course design and instruction.

Credits: variable to 3.0; Repeatable to a Max of 9; Graded Pass/Fail Only

Semesters Offered: On Demand

Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

PSY 5510 - Memory and Learning: Review, Synthesis, and Applications

Review of literature on human memory and learning from behavioral, neural, and applied perspectives. Readings and discussion will focus on foundational research studies that have formed the basis for our knowledge about human memory and learning, with a focus on the implications for applied work in learning, training, and human factors.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand

PSY 5610 - Automation

An overview of the changing role of human users in automated systems. Topics include levels of automation, automation trust issues, automation uses and misuses, and the role of automation in human performance.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

PSY 5620 - Displays and Alarms

An overview of display and alarm design principles for human-machine systems. Topics include visual, auditory, and tactile display design, masking and alarm detection, and the cry wolf effect and alarms.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): PSY 5160

PSY 5750 - Judgment and Decision Making

Decision making is a skill. To improve that skill and design better decision support systems, we examine how people make decisions, sources of power, common biases, and errors. This interdisciplinary approach includes three levels of analysis: descriptive, normative, and prescriptive.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2018-2019 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

PSY 5761 - Human-Robot Interaction

This course covers topics, such as anthropomorphism and embodied, dialogue, emotion, human-robot team interaction, assistive robots, ethical issues, and measurement and evaluation.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

PSY 5770 - Affective Design and Computing

An examination of emotions and affect in Human Factors and HCI. Topics may include brain and cognitive mechanisms and methods/techniques, affective computing, Kansei engineering, hedonomics, emotional design, and application domains.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

PSY 5780 - Introduction to Qualitative Research Methods and Analysis

An introduction to the use of qualitative research methods in social science contexts. Emphasis is placed on understanding the underpinnings of qualitative research, research traditions, and theoretical orientations. Students will be introduced to specific qualitative analysis techniques, ways to interpret data, and writing strategies.

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 Level(s): Graduate

PSY 5850 - Human Factors Psychology

Advanced concepts critical to the design of human-technological systems, such as capitalizing upon human capabilities and compensating for human limitations. Topics may include perceptual and motor abilities, human error and cognitive engineering.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2019-2020 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

PSY 5860 - Human Factors Tools and Techniques

An overview of the tools and techniques used by human factors researchers and practitioners. Topics include task analysis, eye tracking, human error in systems, simulation, workload analysis, and physiological assessment techniques.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2018-2019 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): PSY 5850

PSY 5870 - Human-Centered Design

This course will focus on the human-system (computers, appliances, mobile devices, etc.) interaction regarding the design and development of products. Students will experience a complete cycle of the interaction design project, including analysis, design, and evaluation.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: May not be enrolled in one of the following Class(es): Freshman

PSY 5910 - Independent Research

Research experience, preparation, and data collection for projects that will not result in a thesis or dissertation.

Credits: variable to 12.0; Repeatable to a Max of 21; Graded Pass/Fail Only

Semesters Offered: On Demand

Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

PSY 5999 - Graduate Research

Fundamental and applied research in cognitive science and/or human factors leading to the submission of a thesis or report in partial fulfillment of the requirements for the master's degree.

Credits: variable to 12.0; May be repeated; Graded Pass/Fail Only

Semesters Offered: On Demand

Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

PSY 6990 - Special Topics in Cognitive Science

Study of special topics in cognitive science as designed by section title.

Credits: variable to 3.0; Repeatable to a Max of 9

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

PSY 6991 - Special Topics in Human Factors

Study of special topics in human factors as designed by section title.

Credits: variable to 3.0; Repeatable to a Max of 9

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

PSY 6999 - Doctoral Research

Fundamental and applied research in cognitive science and/or human factors.

Leading to the submission of a dissertation in partial fulfillment of the requirements for the PHD degree.

Credits: variable to 12.0; May be repeated; Graded Pass/Fail Only

Semesters Offered: On Demand

Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

Systems Administration Technology**SAT 5001 - Introduction to Medical Informatics**

Course covers fundamental subjects such as medical decision support systems, telemedicine, medical ethics and biostatistics. Topics include consumer health informatics, international health care systems, global health informatics, translational research informatics and homecare. Students will see medical informatics from diverse perspectives. Scientific writing and communication will be encouraged.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate

SAT 5002 - Application Programming Introduction

Students will develop problem solving skills through the application of a commonly used high-level programming language. Topics include: nature of the programming environment; fundamentals of programming languages; structured programming concepts; object-oriented programming concepts; desirable programming practices and design; and debugging and testing techniques.

Credits: 3.0

Lec-Rec-Lab: (0-2-1)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate

SAT 5111 - Security and Privacy

Examines key health information security, policy, and procedures. Investigates how to distinguish elements of a security audit and key security policies.

Analyzes the roles of people maintaining health information security and explains elements of these roles within the organization.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate

SAT 5114 - Introduction to Artificial Intelligence in Health

Explores AI methods for clinical and healthcare applications with a focus on machine learning (ML). Covers concepts of algorithmic fairness, interpretability, and causality. Considers how AI techniques will shape healthcare policy and precision medicine.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

SAT 5121 - Introduction to Medical Sciences, Human Pathophysiology, Healthcare

Course provides basic concepts in medicine and human pathophysiology to introduce a molecular understanding of human metabolism and disease. Topics also include physical examination of patient, taking medical history, laboratory medicine, disease management and treatment, medical diagnostics, clinical workflow, and medical special/subspecialties.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate

SAT 5131 - System Analysis and Design

Provides knowledge of tools available to perform systems analysis, examines key factors in systems design, emphasizes importance of communication, and an understanding of the primary factors in systems implementation. Course will examine strategies, risks, and key factors in purchasing systems.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

SAT 5141 - Clinical Support Modeling

Course addresses complex medical decisions, evidence-based medicine, disease management and comprehensive laboratory informatics. Topics include improving physical order entry and healthcare, using medical literature, clinical case discussions, meaningful use of medical data, enhancing patient and caregiver education, disease prevention, and public health and environmental health informatics.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall, Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Co-Requisite(s): SAT 5114

SAT 5151 - Application Integration and Interoperability

Defines and explains the role of interoperability in the development of a functioning EHR. Analyzes predominant standardization in the healthcare field such as ASTM and HL7. Examines the challenges to the development of interoperability in healthcare.

Credits: 3.0

Lec-Rec-Lab: (0-2-1)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate

SAT 5161 - Data Warehousing and Business Intelligence

Identifies database solutions and key elements of an enterprise data warehouse. Explains how to apply best practices for development of data warehouses, the role of business intelligence and data mining in supporting the strategic business decision process, and OLAP (Online Analytical Processing) and its use in reporting and analyzing database and data warehouse information. Defines security practices for a data warehouse environment.

Credits: 3.0

Lec-Rec-Lab: (0-2-1)

Semesters Offered: Fall, Summer

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): SAT 3210

SAT 5171 - Human-Computer Interaction in Healthcare

Addresses human-computer interaction (HCI) evaluation methods and their applications in the healthcare domain. Topics include: user-centered design; measurements in HCI; usability testing; experimental research; data collection methods; statistical analysis; and qualitative data analysis. Software programming language R will be used.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): CS 1111 or SAT 5002

SAT 5231 - Statistical Methods for Intrusion Detection

An introduction to the data and methodologies of computer intrusion detection. Focuses on statistical and machine learning approaches to detection of attacks on computers. Topics include network monitoring and analysis, network-based attacks such as probes and denial of service, host-based attacks such as buffer overflows and race conditions, and malicious code such as viruses and worms. Statistical pattern recognition methods will be described for the detection and classification of attacks.

Credits: 3.0

Lec-Rec-Lab: (0-2-1)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

SAT 5241 - Designing Security Systems

Provides an overview of techniques used in the design of secure systems with a primary focus on real-world case studies. Students will examine attacks on deployed systems and investigate how these vulnerabilities have been addressed. Practical advantages and shortcomings of several notions of provable security will also be examined. Students will be expected to read, understand, and present recent research papers.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): SAT 5111

SAT 5251 - Advanced Topics in Network Security

Focuses on advanced research topics in communications security. The course is structured as a research seminar where students present research papers.

Topics include protocol analysis, security in inter-domain routing, broadcast authentication protocols, covert channels and anonymous communication, key management, advanced trace-back schemes, and attack propagation modeling. A course project is required.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): SAT 5231 or SAT 5241

SAT 5255 - Medical Imaging I

Introduction to the underlying physics, image formation theories and application of imaging methods used in medicine. This course is not a comprehensive presentation of imaging science but is an overview of the characteristics of each modality and their use.

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): BL 2010 or BL 3080 or EH 1500 or KIP 1500

SAT 5256 - Medical Imaging II

Continuation of Medical Imaging I presenting more advanced imaging methods and their use in medicine. Topics such as MRI and Ultrasound will be covered in depth.

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): SAT 5255

SAT 5261 - Medical Image Analysis

Overview of medical image analysis techniques. Topics will include: fundamentals of medical imaging; image enhancement; image compression; image segmentation; noise reduction; image registration; content-based medical image retrieval, feature extraction and image recognition; and computer-aided diagnosis and detection systems.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): CS 1111 or SAT 1200

SAT 5283 - Information Governance and Risk Management

Course will consist of the legal and regulatory requirements and security privacy concept principles regarding healthcare information. Best practices of how organizations manage information risk through risk assessment practices and procedures will be conducted.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2018-2019 academic year

Restrictions: Must be enrolled in one of the following College(s): School of Technology

SAT 5422 - Clinical Applications

Introduces the concepts and processes of clinical applications. Critical insight into the medical field will be provided by blending both the clinical and medical informatics perspectives. Students will gain hands-on clinical application experiences within predefined clinical settings.

Credits: 3.0

Lec-Rec-Lab: (0-2-2)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate

SAT 5424 - Population Health Management and Monitoring

Introduces organization context of health data for the use of managing populations. Types of health data sources, interventions, data analytics, and policy factors affecting population health are covered. Also explores how information is used for managing population health surveillance.

Credits: 3.0

Lec-Rec-Lab: (0-2-2)

Semesters Offered: Spring, Summer

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): SAT 5001 and SAT 5114

SAT 5600 - Web Application Development

An introduction to the building and administration of web applications. Topics covered include: Apache web server development; Tomcat application server; HTML; cascading style sheets; JavaScript; JQuery; server side includes; server side application development; web services; SSL/TLS; and authentication/authorization.

Credits: 3.0

Lec-Rec-Lab: (0-2-2)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): SAT 5002

SAT 5761 - Introduction to Hadoop and Applications

This course will introduce the basic concepts of the Hadoop system. Topics include: programming languages for Hadoop, Hadoop Architecture, MapReduce, administration of Hadoop clusters, Hadoop input and output; basic concepts of Yarn, Spark, Pig, HBase, and Hive, and the applications of Hadoop for data analysis.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Summer

SAT 5816 - Digital Forensics

Introduction of the basic principles and technology of digital forensics, including acquisition, preservation, and recovery and investigation of the evidence stored in digital devices.

Credits: 3.0

Lec-Rec-Lab: (0-2-2)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): SAT 2511 and (SAT 2711 or SAT 5111)

SAT 5817 - Security Penetration Testing and Audit

To provide knowledge and demonstrated methods to help prevent security breaches and develop safeguards to protect sensitive information and confidential data. Primary focus will be on the healthcare sector. Students learn offensive and defensive security concepts, audit best-practices.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2018-2019 academic year

Restrictions: Must be enrolled in one of the following College(s): School of Technology

SAT 5990 - Special Topics in Medical Informatics

Medical informatics topic of interest to the faculty and student.

Credits: variable to 3.0; Repeatable to a Max of 12

Semesters Offered: On Demand

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

SAT 5998 - Practical Experience in Medical Informatics

The study of an acceptable medical informatics research problem and the preparation of a report.

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 Level(s): Graduate

SAT 5999 - Thesis Research in Medical Informatics

The study of an acceptable medical informatics research problem and the preparation of a thesis.

Credits: variable to 10.0; Repeatable to a Max of 10; Graded Pass/Fail Only

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

Social Sciences**SS 5001 - Advanced Social Science Methods**

Introduction to quantitative and mixed methods research in the social sciences. Topics include: survey design, sampling frames, data collection and analysis, error estimation, and the application of statistical methods. Literature will highlight the use and misuse of advanced methods.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand

SS 5003 - Survey Methods

A general introduction to survey methods. Students will learn the basics of survey design from questionnaire construction to the measurement of complex social science concepts. Students will also demonstrate their ability to conduct an original survey through a class project.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2018-2019 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

SS 5004 - Statistics for the Social Sciences

A general introduction to quantitative analysis for the social sciences. The course uses common statistical software tools, such as SPSS, to aid in the analysis of data. Students apply their data analysis techniques to social science problems of their choosing in a semester-long project.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2019-2020 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

SS 5005 - Introduction to Computational Social Science

An introduction to computational methods for the social sciences. The course provides an introduction to complexity theory and Agent-Based Modeling. Students will apply what they have learned in this course to develop a pilot simulation to understand any social phenomena of their choosing.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

SS 5010 - Directed Study

Directed readings or research conducted under the direction of a member of the graduate faculty. Students must meet with their supervising instructor and receive approval of their study plan before registering.

Credits: variable to 4.0; Repeatable to a Max of 9

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

SS 5015 - Cultural/Environmental Office of Surface Mining VISTA Field Service Internship

Students enroll in this course during a supervised field experience dealing with natural and cultural heritage, natural or cultural resources, and/or community development. This course allows progress toward MS degrees in Industrial Archaeology and Environmental and Energy Policy while serving as an intern through OSM VISTA.

Credits: 1.0; May be repeated

Lec-Rec-Lab: (0-0-3)

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Industrial Archaeology, Environmental Policy

SS 5049 - GIS Applications for the Graduate Researcher

Applications of Geographic Information Science and Technologies for research problem identification, analysis, and dissemination. Students learn how to use GIS as a tool to collect and analyze qualitative and quantitative data for graduate research. Hands-on experience in data collection, analysis, and problem solving.

Credits: 3.0

Lec-Rec-Lab: (1-0-2)

Semesters Offered: Fall - Offered alternate years beginning with the 2018-2019 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

SS 5050 - Advanced GIS Methods and Projects

Advanced application of Geographic Information Systems in social sciences as a tool to collect and analyze qualitative and quantitative data. Students gain hands-on experience in data collection, advanced spatial analysis, and scripting.

Credits: 3.0

Lec-Rec-Lab: (1-0-2)

Semesters Offered: Fall - Offered alternate years beginning with the 2019-2020 academic year

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): SS 5049

SS 5201 - Cultural Dimensions of International Immersion and Research

Students reflect on their culture and assumptions about the world; discuss conducting research responsibly; consider structural, material, and historical dimensions of social problems and social change; and explore how to live and work effectively with people from other cultural groups.

Credits: 1.0

Lec-Rec-Lab: (0-0-2)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

SS 5230 - Archaeological Analysis and Interpretation

Course focuses on how archaeologists mobilize material data to understand everyday life in the past. Discussion, exercises, and lab time are used to cover the goals of archaeology, nature of archaeological data, research design, sampling, typology, classification, database management, and quantitative and qualitative analytical methods.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand - Offered alternate years beginning with the 2017-2018 academic year

SS 5300 - Environmental and Natural Resources Policy

An overview of environmental and natural resource policies in the U.S. and internationally. Emphasizes policies regarding forests, wildlife, public lands, pollution, and climate change. Discussion of policy administration by the USDA Forest Service and National Park Service.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2019-2020 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

SS 5301 - The Policy Process

This course introduces key concepts in the policy making process (agenda, setting, formulation, decision-making, implementation, and evaluation). Theories of policy change are also introduced.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall, Spring - Offered alternate years beginning with the 2016-2017 academic year

SS 5302 - Environmental Governance and Decision Making - Nature, Culture, and Power

Reviews the dominant social scientific narratives related to understanding interactions between society and the environment. Involves learning to think critically about environmental problems and the social, political, and cultural contexts in which these problems arise.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

SS 5310 - Ecological Economics

Ecological economics starts with a preanalytical vision that the economy is a sub-system of the Earth's ecological systems. Foundational topics include examination of the optimal scale of the economy, efficient allocation of resources, and the equitable distribution of resource flows.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

SS 5313 - Sustainability Policy

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

Restrictions: Must be enrolled in one of the following Level(s): Graduate

SS 5315 - Population and Environment

This course investigates relationships between the world's population, population change, population distribution, resource consumption, and environmental and social consequences. Addresses local and global relationships and the population processes (mortality, fertility, and migration) involved.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand

Pre-Requisite(s): SS 5400(C) or SS 3760 or FW 3760

SS 5320 - Special Topics in Environmental Policy

An intensive, student-led seminar focused on environmental and sustainability policy issues at local, regional, or global scales. Topics may include climate change, pollution, sustainable agriculture or development, environmental justice, globalization, or other current topics. May be repeated if topic differs.

Credits: variable to 3.0; Repeatable to a Max of 9

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

SS 5325 - Water Policy, History, and Governance

This seminar will explore the global history, politics, and governance of freshwater resources. Topics will include the effects of forestry, mining, watershed management, sanitation systems, privatization, climate change, fisheries, emerging contaminants, and agriculture on water systems and policies.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2016-2017 academic year

SS 5330 - Advanced Topics in Energy Policy

An intensive student-led seminar focused on energy policy issues at local, regional, or global scales. Topics may include climate change, renewable energy, energy efficiency, nuclear wastes, and government mandates. May be repeated if topic differs.

Credits: variable to 3.0; Repeatable to a Max of 9

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

SS 5350 - Environmental Policy Analysis

An overview of the policy process, including a detailed review of the major instruments that are used by federal, state, regional, and local governments.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2018-2019 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): SS 5300 and EC 2001

SS 5400 - Sociology of the Environment

Provides students with an introduction to basic sociological concepts as they apply human relationships to the environment. Topics include social values, organizations, norms, ideologies, and political systems. Themes will include the relationship of expertise to lay knowledge, public participation, and urban-rural relationships.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2015-2016 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

SS 5500 - History of Technology

Provides a basic introduction to work in the history of technology.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2013-2014 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

SS 5501 - Industrial Communities

A graduate seminar covering studies of industrial communities. Introduces the methods and approaches of this field through reading and discussion of selected articles and case studies.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2013-2014 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

SS 5502 - Historical Archaeology

Graduate seminar covering the essential elements of historical archaeology through reading and discussion of selected articles and case studies.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2019-2020 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

SS 5503 - Material Culture Studies

Graduate seminar covering the basic elements of material culture studies through readings, discussion, and projects.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2019-2020 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

SS 5530 - Deindustrialization and the Urban Environment

This course examines economic, environmental, and social problems associated with deindustrialization in postwar North American cities and the strategies adopted to ameliorate them. Major topics include segregation and housing, environmental regulation, environmental justice, industrial heritage, and economic and urban development policy.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2016-2017 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

SS 5550 - Global Environmental History

Examines changes in human interactions with earth systems over time, starting with the development of agriculture and continuing to the present—with flows of material through economies and ecologies now intertwined in complex ways. Places the notion of sustainability in historical perspective.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2015-2016 academic year

SS 5551 - Global Industrial History

Graduate seminar examining the interlinked processes of industrialization and globalization ca. 1700-present. The course covers key theoretical debates and explores different methodological approaches through case studies of selected topics and themes.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2018-2019 academic year

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

SS 5600 - Industrial Archaeology

Directed readings and lectures in industrial archaeology using wide range of material from the historical engineering and archaeology literature. Central focus is on regional case studies. Students complete a substantial directed research project.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring - Offered alternate years beginning with the 2018-2019 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

SS 5635 - International Environmental Policy

This course delves into the international law associated with environmental issues. Students begin with the treaty language and associated jurisprudence (if any) and then study how the treaty was negotiated, adapted by national governments, and used in political discourse.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

SS 5700 - Archaeological Field Methods

Practical experience in methods and techniques of field archaeology. Background readings followed by participation in site survey, testing, excavation, and record keeping. Students involved in ongoing research projects in upper Great Lakes Region. Offered with SS 3210. Graduate students complete independent project in addition to regular work. Recommended SS2020.

Credits: variable to 8.0; Repeatable to a Max of 16

Semesters Offered: Summer

Restrictions: Must be enrolled in one of the following Level(s): Graduate

SS 5720 - Social Thought and Contemporary Issues

This course reviews the ways social scientists understand the nature of social organization, how these ideas have changed over time in concert with particular socio-historic transformations, and how, specifically, these ideas relate to understanding interactions between industrial society and the environment.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall

SS 5800 - Documentation of Historic Structures

Principles and practice of survey and documentation of historic structures. Techniques include reconnaissance survey, in-depth survey, measured drawings, architectural photography, primary research, and written descriptions. Students use survey and documentation to analyze historic structures.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2012-2013 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

SS 5820 - Advanced, Ethical, Legal and Societal Implications (ELSI) of Nanotechnology

Advanced exploration of the implications of molecularism as brought about by emergent nanotechnology and nanoscience. Involves comparative investigations, extended reading and writing assignments in seminar setting.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

SS 5900 - Heritage Management

Introduces the current field of heritage management; the legislation that underwrites its practice; the articulation of federal, state, and local governmental activity; the evolving philosophies of archaeologists and historic preservationists operating in the public interest; parallels on the international scene; and the impacts of heritage tourism.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

SS 5950 - Professional Development

This course will prepare graduate students in the social sciences department for the expectations for success in graduate school and future careers. The course will provide a foundation in understanding academic and professional development, including research, presentations and conference attendance, and professional preparation.

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

SS 5990 - Graduate Research

Individual research work leading towards master's thesis or project. Open by arrangement to students in master's programs in the Department of Social Sciences.

Credits: variable to 10.0; May be repeated; Graded Pass/Fail Only

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Level(s): Graduate

SS 6002 - Research Design

This objective of this course is to explore the fundamentals of research design and analysis, particularly as these are applied to identifying, initiating, carrying out, and completing a thesis or dissertation research in environmental and energy policy.

Credits: 3.0

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Spring

Restrictions: Must be enrolled in one of the following Level(s): Graduate

SS 6010 - Special Topics in Industrial Heritage

Examines themes or topics related to studies of industrial heritage. May include such topics as advanced cultural resource & heritage management and tourism; industrial heritage field methods; international dimension of industrial heritage; government policy. May be repeated.

Credits: variable to 6.0; Repeatable to a Max of 12

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

SS 6020 - Special Topics in Industrial History

Examines themes or topics related to the study of industrial history of technology. Topics may include global history of industrialization; theoretical models of industrial evolution; and social history of technology and work. May be repeated.

Credits: variable to 6.0; Repeatable to a Max of 12

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

SS 6100 - Advanced Seminar in Energy and Climate Policy

This course will review the complex process of energy policy making in the U.S. focusing on political, economic, social, organizational, and technological dimensions. Students will examine the prospects for policy change in the light of global climate change.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2012-2013 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

SS 6500 - Directed Reading/Independent Study

Directed reading or independent study with appropriate faculty at the graduate level.

Credits: variable to 9.0; May be repeated

Semesters Offered: Fall, Spring, Summer

Restrictions: Must be enrolled in one of the following Level(s): Graduate

SS 6600 - PhD. Dissertation Research

Fundamental and applied research in industrial heritage, industrial archeology, history of technology, and in environmental and energy policy. Taken by graduate students in partial fulfillment of the PhD thesis requirements.

Credits: variable to 9.0; May be repeated; Graded Pass/Fail Only

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

Surveying**SU 5002 - Infrared Technology, Sensors, and Applications**

Infrared remote sensing fundamentals, current and future technologies, and applications are considered. Remote sensing for both civilian applications such as environmental resource mapping and military applications will be included.

Credits: 1.0

Lec-Rec-Lab: (0-1-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

SU 5004 - Introduction to Geospatial Image Processing

Introduction to the basic concepts of Image Processing and Understanding. Applications focus on preprocessing of satellite and aerial images, remote sensing, and image/video enhancement. This course will provide mathematical foundations and explore modern practical algorithms and methods.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

SU 5010 - Geospatial Concepts, Technologies, and Data

High-level review of geospatial data acquisition systems, sensors and associated processing technologies. Course considers geospatial metadata generation principles, interoperability, and major tools for manipulation with geospatial data. Course may help in transition of non-geospatial majors to geospatial field.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

SU 5011 - Cadastre and Land Information Systems

Topics include: an introduction to land rights, land ownership, lease, and traditional rights, mortgaging and land as capital, description of land rights, boundary description, land information systems, examples of cadastre types over the globe, and modern technical aspects.

Credits: 3.0

Lec-Rec-Lab: (0-2-1)

Semesters Offered: Fall - Offered alternate years beginning with the 2019-2020 academic year

SU 5012 - Geospatial Data Mining and Crowdsourcing

This course comprises theory and applications of geospatial data mining. Typical application scenarios are covered. Attention is given to open-source data and systems crowdsourcing, as well as social media. Special focus on imaging and visual analytics.

Credits: 3.0

Lec-Rec-Lab: (0-2-1)

Semesters Offered: Spring - Offered alternate years beginning with the 2020-2021 academic year

SU 5013 - Hydrographic Mapping and Surveying

This course comprises theory and applications of hydrographic mapping technologies. Typical application scenarios are covered. An intensive lab component provides hands-on experience in hydrographic data processing and visualization.

Credits: 3.0

Lec-Rec-Lab: (0-2-1)

Semesters Offered: Spring

SU 5020 - Data Analysis and Adjustments

Course explores fundamentals of mathematical error propagation theory including various observation equations, least squares adjustment, and Kalman filter methods. Blunder detection, decorrelation, and inversion of patterned large matrices processes are considered. Involves analysis of position estimation deploying geospatial measurements.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

SU 5021 - Geodetic Models

Course provides solid geospatial background in geodetic reference frames: datums; geoids; and reference ellipsoids. 2D and 3D geodetic network adjustments are considered based on 3D spherical models.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): SU 5020(C)

SU 5022 - Positioning with GNSS

In-depth study of GPS, GLONASS, Galileo, COMPASS satellite systems, theory, and processing of global positioning measurements. Strongly recommended for geospatial practitioners.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): SU 5020

SU 5023 - Geospatial Positioning

High-level summary of GPS-GAP courses. This course is intended for interdisciplinary graduate students who seek just ONE combination course in adjustments, geodesy and GPS (with emphasis on GPS/GNSS). Not available to students who have taken SU5020, SU5021, SU5022.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

SU 5142 - 3D Surveying and Modeling with Laser Scanner Data

Theory and application of terrestrial LIDAR scanning. Typical application scenarios are also included. Intensive lab component provides hands-on experience in LIDAR point cloud processing and visualization.

Credits: 3.0

Lec-Rec-Lab: (0-2-1)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

SU 5540 - Advanced Photogrammetry - Satellite Photogrammetry

Fundamentals of spaceborne imaging systems relevant to topographic mapping. Imagery products: preprocessing levels and metadata. Specific methods of space photogrammetry. Review of contemporary spaceborne imaging systems and imagery products available. Airborne non-frame sensors and photogrammetric processing of the imagery.

Credits: 3.0

Lec-Rec-Lab: (0-2-3)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): SU 4140

SU 5541 - Close-range Photogrammetry

The main topics that will be covered are: math fundamentals; imaging technology; the photogrammetric process; image acquisition planning; interior orientation; bundle block adjustment; 3D plotting; orthorectification; image-matching techniques; and close range photogrammetry applications.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): SU 4140

SU 5800 - Geospatial Master's Graduate Seminar

Student presentations of geospatial related research. Graduate committee organization assistance, presentation skills training and guidance for final Master's research presentation.

Credits: 1.0

Lec-Rec-Lab: (0-1-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

SU 5930 - Synthetic Aperture Radar (SAR) Fundamentals and Applications

Review of radar concepts, applications of SAR (InSAR) data, types of available satellite/airborne systems, and data processing methods. Applications for creating topographic data, recognizing targets, classifying ice and vegetation, and oceans/large lakes will be presented based on real-world examples.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

SU 5990 - Special Topics in Integrated Geospatial Technology

Integrated Geospatial Technology topic of interest to the faculty and student.

Credits: variable to 3.0; Repeatable to a Max of 12

Semesters Offered: On Demand

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

SU 5998 - Practical Experience in Integrated Geospatial Technology

The study of an acceptable geospatial related research problem and the preparation of a report.

Credits: variable to 6.0; Repeatable to a Max of 6

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

SU 5999 - Thesis Research in Integrated Geospatial Technology

The study of an acceptable geospatial related research problem and the preparation of a thesis.

Credits: variable to 10.0; Repeatable to a Max of 10; Graded Pass/Fail Only

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

Technology**TE 5000 - Independent Study in Technology**

Students undertake an independent study in an approved technology topic under the guidance of a School of Technology faculty member. The course of study may either be research or academic and is decided upon between the student and faculty member.

Credits: variable to 3.0; Repeatable to a Max of 6

Semesters Offered: On Demand

Restrictions: Permission of instructor required; May not be enrolled in one of the following Class(es): Senior

TE 5001 - Special Topics in Technology

Topics of special interest in technology will be offered depending on student demand and faculty interest or expertise.

Credits: variable to 3.0; Repeatable to a Max of 12

Semesters Offered: On Demand

Restrictions: Permission of instructor required; Must be enrolled in one of the following Level(s): Graduate

TE 5100 - Systems Design and Integration

System specification and design with an overview of technical performance measurements, activity management, risk management, decision analysis, cost analysis, and concurrent engineering. A broad view of customer and vendor integration, design reviews, quality systems, producibility, and sustainability are also presented.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

TE 5200 - Systems Quality and Reliability

Technology and methodology for setting standards and measuring component performance. Testing and methods for evaluating internal and external subcontractor components and data are also presented. Contemporary issues of continuous improvement in quality and manufacturing, 6-sigma, and service industries are examined. Documentation related to offshore manufacturing is also introduced.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

TE 5300 - Systems Project Management

Management techniques for large scale projects with multiple components and subsystems. Includes establishing and tracking responsibilities and costs of both internal and external value streams. Methods of investigating delivery, payment, and mechanical performance are also presented.

Credits: 3.0

Lec-Rec-Lab: (0-3-0)

Semesters Offered: On Demand

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore, Junior

University Wide**UN 0500 – Effective Scholarship**

Course meets federal requirements for responsible conduct of research training for graduate students. Students who pass the course will be awarded a certificate of completion.

Credits: 1.0; Graded Pass/Fail Only

Lec-Rec-Lab: (0-2-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

UN 5000 - Graduate Cooperative Education I

Credits may count as free or technical electives based on academic department. Requires advisor approval, good standing, registration with Career Services, and an official letter.

Credits: variable to 6.0; May be repeated

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

UN 5001 - Advanced Responsible Conduct of Research

Three, 4 hour workshops on advanced responsible conduct of research. Covers topics necessary for this training, including ethical standards, publication practices, peer review process, conflict of interest and societal expectations.

Credits: 1.0

Lec-Rec-Lab: (1-0-0)

Semesters Offered: Summer

Restrictions: Must be enrolled in one of the following Level(s): Graduate

UN 5002 - Graduate Cooperative Education II

Credits may count as free or technical electives based on academic department. Requires advisor approval, good standing, registration with Career Services, and an official offer letter.

Credits: variable to 6.0; May be repeated

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): UN 5000

UN 5003 - Graduate Cooperative Education III

Credits may count as free or technical electives based on academic department. Requires advisor approval, good standing, registration with Career Services, and an official offer letter.

Credits: variable to 6.0; May be repeated

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): UN 5000 and UN 5002

UN 5004 - Graduate Cooperative Education IV

Credits may count as free or technical electives based on academic department. Requires advisor approval, good standing, registration with Career Services, and an official offer letter.

Credits: variable to 6.0; May be repeated

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

Pre-Requisite(s): UN 5000 and UN 5002 and UN 5003

UN 5100 - Water and Society Colloquium

Seminar based class covers current topics in water resources. Objectives: build towards a common literacy on water resources issues; identify areas of common interest among students and faculty in water resources topics.

Credits: 1.0; Repeatable to a Max of 2

Lec-Rec-Lab: (0-1-0)

Semesters Offered: Spring

Restrictions: Permission of instructor required

UN 5200 - Interdisciplinary Colloquium

An interdisciplinary discussion-focused course covering special topics as specified by section title.

Credits: variable to 3.0; May be repeated

Semesters Offered: On Demand

Restrictions: May not be enrolled in one of the following Class(es): Freshman, Sophomore

UN 5390 - Scientific Computing

Set in a Linux environment, course offers exposure to Foss tools for developing computational and visualization workflows. Students will learn to translate problems into programs, understand sources of errors, and debug, improve the performance of and parallelize the code.

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

UN 5400 - Climate Science and Policy

An interdisciplinary discussion-format course covering the basic science of climate change and the development of international climate policy. Includes an analysis of policy targets in their scientific context and links to global sustainable development goals. Additional topics will be guided by the interests of the class and current events.

Credits: 3.0; Repeatable to a Max of 6

Lec-Rec-Lab: (3-0-0)

Semesters Offered: Fall - Offered alternate years beginning with the 2019-2020 academic year

Restrictions: Must be enrolled in one of the following Level(s): Graduate

UN 5500 - Advanced Research Integrity

Three 4-hour workshops introduce students to the principles, practices, and regulations of responsible conduct research. Topics might include: societal expectations; professional and ethical standards; conflicts of interest; peer review; collaboration; publication and authorship; research misconduct; violations and sanctions.

Credits: 1.0

Lec-Rec-Lab: (0-1-0)

Semesters Offered: On Demand

Restrictions: Must be enrolled in one of the following Level(s): Graduate

UN 5550 - Introduction to Data Science

Course provides an introduction to Big Data concepts, with focus on data management, data modeling, visualization, security, cloud computing, and data science from different perspectives: computer science, business, social science, bioinformatics, engineering, etc. Course introduces tools for data analytics such as SPSS Modeler, R, SAS, Python, and MATLAB. Two case study projects which are integrated with communication and business skills.

Credits: 3.0

Lec-Rec-Lab: (2-0-3)

Semesters Offered: Fall

Restrictions: Must be enrolled in one of the following Level(s): Graduate; Must be enrolled in one of the following Major(s): Data Science

UN 5951 - Graduate Status - Maintenance of Continuous Enrollment

Meets continuous enrollment requirement for graduate students needing "time out" for special circumstances (such as active military duty) and for online programs with inactive terms.

Credits: 0.0; May be repeated; Graded Pass/Fail Only

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

UN 5953 - Graduate Status - Maintenance of Continuous Enrollment

Course can be used to meet the minimum one credit enrollment requirement for graduate students. Students enrolled in research-oriented degree programs must instead register in one credit of research with the appropriate faculty member.

Not available to students who need to be enrolled fulltime with 9 credits.

Credits: 1.0; Graded Pass/Fail Only

Lec-Rec-Lab: (0-1-0)

Semesters Offered: Fall, Spring, Summer

Restrictions: Permission of department required; Must be enrolled in one of the following Level(s): Graduate

UN 5990 - Special Topics - Interdisciplinary

Study of interdisciplinary special topics as specified by section title.

Credits: variable to 6.0; May be repeated

Semesters Offered: On Demand

Restrictions: Permission of instructor required